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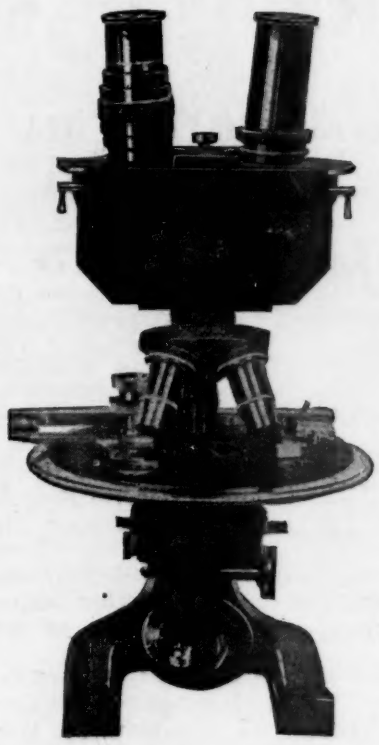

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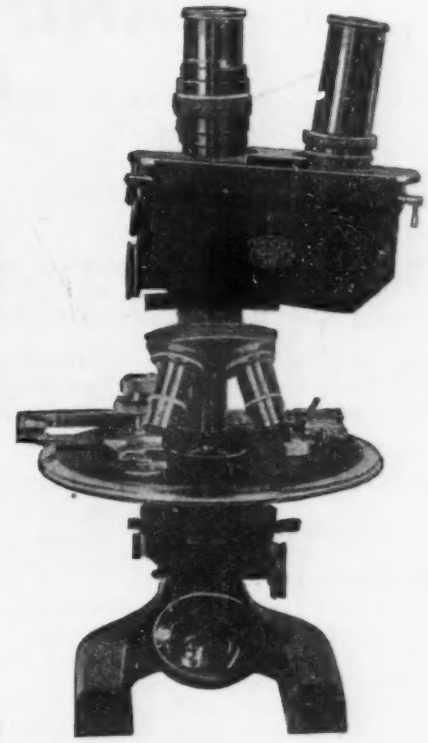

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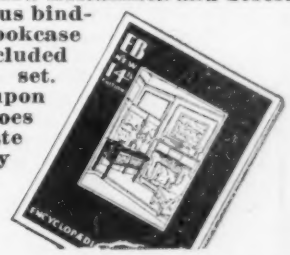

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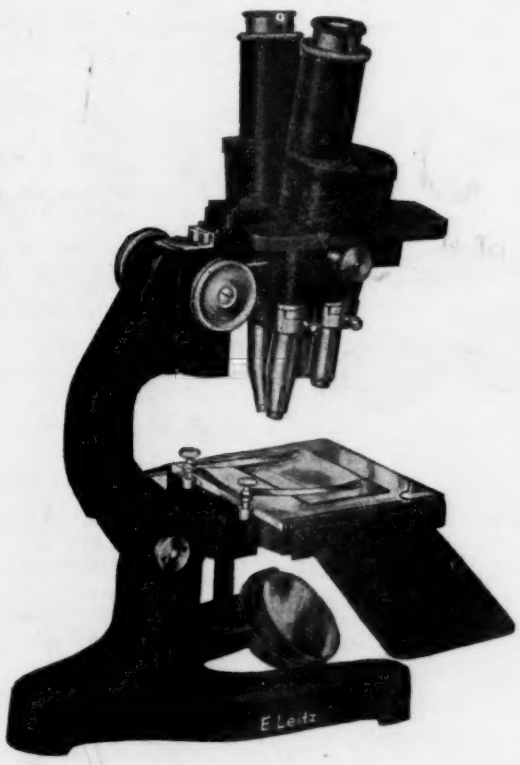

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THE BINDING INFLUENCE OF A LIBRARY ON A SUBDIVIDING PROFESSION[1]

By Dr. HARVEY CUSHING

> Learning as with water is never more fair,
> pure and simple than at its source.—*Naudé.*

THE dedication of a library is usually a commonplace event which calls for certain platitudes, perhaps even a prayer. The generosity of the donor is praised, the genius of the architect; the educational needs of the people (other than those present) are recalled and assurance given that they will be met so far as a meagre endowment permits. Attention is next drawn to the novel features of the building and then, with some relief, all adjourn for lunch.

This, ordinarily, is the culminating feature of the programme, for Nature, while providing all alike with a ready impulse to consume food, omitted to equip most of us with an intellectual hunger whose recurrent pangs can be assuaged only by the consumption of books, the invention of which she could scarcely have foreseen.

[1] Address at the dedication of the William H. Welch Medical Library, Baltimore, October 17, 1929.

Meanwhile, no reference has been made to that important official, the librarian, who modestly sits in the background with napkin on knee cogitating over possible ways of developing, on the part of those within the radius of his activity, such conditioned reflexes as would salivate them, no less promptly, at the mere sight of the printed page. A cafeteria system perhaps with appetizing books on view rather than distant and uncertain books ordered *à la carte.*

Too often libraries are but the graveyard of forgotten books whose oblivion is disturbed only by the exigencies of the time which has necessitated their transfer, for lack of space, from a smaller cemetery to a larger, where provision, usually inadequate, is made for books still alive and books yet unborn. There, according to age, family, place of origin or circumstance, their epitaphs renewed and coverings repaired, they are redeposited in burial vaults, soon to be once more as forgotten as were the tablets of Sardanapalus, except by the stray seeker for the curious or the

occasional visitor whose interest lies in the tomb rather than what it holds. To this sad end do books usually come. It is their ultimate destiny, at public or private expense, thus to get interred.

But there is a spirit-world of books, and the ideas they contain wander forth to haunt and torment those whose grasp they can elude, to solace or stimulate those who have learned the secret of their capture. For these fortunate ones, it becomes possible: "To be present as it were in every age—to extend and stretch life backward from the womb." From the spirit that hovers over some obscure volume, of parentage and birthplace unknown, times forgotten may be reconstructed, the sequence of discovery unraveled, the tendencies of thought traced, the relation of yesterday and to-morrow better understood.

This, then, is the true function of the library, to quicken the dormant book so that it may speak again; and with those who treat it lovingly and compassionately, its spirit enters eagerly into communion. To these a library becomes a laboratory for the crystallization of ideas perhaps long expressed, out of which process new ideas have their birth.

Can witchery such as this come from a repository of books that record the bygone happenings and hypotheses of so practical and forward-looking a profession as that of Medicine? Her concepts of one day are antiquated the next and, busy with the accumulation of new facts, she spares little time to integrate them and thinks for the most part only in terms of the present. But philosophers tell us there is no present, that the event of the moment is already history; and, if this be so, what is now taking place may possibly prove to have been one of the most significant of the many important things that have happened here since the formal opening of the neighboring hospital just forty years ago.

Ever since the University itself began to take form under the guidance of Daniel Coit Gilman, this place has been a crucible in which experiments in education have fearlessly been put to the test. There may yet be another that will centre in this building if he whose name it bears can long enough be spared properly to direct its course. Medicine has become so scattered and subdivided that there is crying need for some one to lead it from the wilderness and again bind it together. And whether this can be successfully brought about through the ministration of a Chair of the History of Medicine in close cooperation with a great library depends, like all other things in life, less on principle than on personality. Let us, by looking back, endeavour to follow the steps of our prolific dismemberment.

We know from ancient records that physic "was early fathered upon the Gods," and yet, though the physician in the beginning was half priest, it was not beneath his dignity to put hands as well as thoughts to the therapeutic necessities of his art. Medicine was a compact whole and the Aesculapian disciple heard the master expound the entire subject from authoritative codices. Then the doer was honored no less than the thinker, and though his material was perishable, the doctor in his way might be no less an artist than those who carved with a chisel or painted with a brush or built temples from stone and mortar—indeed he might be both, as once was Imhotep.

Though the story is veiled in great obscurity, we may assume that Medicine was still fairly compact when in the ninth century Constantine the African was supposedly lecturing at the school, founded, legend tells us, by a Greek, a Jew, a Latin and a Saracen, in that little seaside town of Salerno. But ere long, to the great misfortune of the maturing profession, a cleavage took place—the first of an unending series. The thinkers rose superior to manual tasks and for centuries became involved in a metaphysical snarl of therapeutic subtleties which led them nowhere. The leech "try'd ev'ry health restoring Herb and Gum," while the despised doers for the most part became degraded into bone-setters, tooth-pullers or itinerant cutters for stone and the fistula. To anatomize the dead body other than to prepare it for burial was a desecration; to open it during life even for such trifling purposes as the letting of blood was debasing and left to the barber. Not until long after, when the treatment of wounds-by-gunshot made the barber-surgeon more indispensable than ever in time of war, did his professional status, in a measure, come to be so restored that even to this day the army doctor, now mainly a health official, continues to be called surgeon.

All this has been often told, for early medicine had not only its thinkers and doers but also its recorders. From Greek to Arabic to Latin through the Dark Ages the ancient doctrines were transcribed and transmitted, accessible only to the classical scholar. The doer meanwhile, educated for the most part solely in the school of experience, could write, if at all, in the vernacular alone, and in consequence we know less about him, for the simple reason that his fugitive compositions were literally read to pieces.

When in the course of time word went forth through Europe that some learned jurists of Bologna were publicly teaching there the principles of civil and later on canon law, like moths to a beacon, students from both sides of the Alps, ultramontane and citramontane, secular and ecclesiastical, swarmed by thousands to the plains of Emelia. There a scholastic guild, representing the first organized university of scholars to be under civic protection, came into being; and promptly the inevitable cleavage into subsidiary guilds began to take place.

Separation rather than conglomeration, fission rather than fusion, is the natural law, and, what is more, it is a biological principle that all fissions occur with violence and strife. The interrupted motion picture has shown that so simple a process as the division of the single cell occurs with an agonizing wrench after a prolonged and unbelievable turmoil of the chromosomes. Could a similarly spaced picture of medical history, or any history for that matter, pass quickly before one's eyes, it would show countless separatist movements accompanied by remonstrance, strife, even bloodshed.

So the *Giuristi* of Bologna resisted mightily when the artists—the *Artisti*—including the students of letters, of philosophy, of mathematics and of medicine, revolted and broke away from them to start an independent body with a rector of its own. This, then, was the beginning of segregation in the *Studium Generale,* and the process, once started, has acquired in the intervening centuries an ever-accelerating speed.

Out of the swarm of *Artisti,* those students inclining to Medicine soon came to be the most favoured and most flourishing group and, for a time, owing doubtless to the search through nature for influences and substances of possible therapeutic value, other subsidiary and allied arts came into being—the study of the constellations, of fossils, of minerals, of plants, of animals—of everything, in short, formerly embraced in that one of the three philosophies called natural.

One by one each of these studies, grown to its own estate, has come to be wholly separated off from the healing art as no longer strictly pertaining to it, Botany after a lingering contact being the last, to our great loss, to sever its allegiance. So a succession of subjects, born of Medicine, outgrow their therapeutic application, renounce their further relationship to an art that would hold them subservient and ultimately break away to pursue an independent course.

Medicine of those early days, based almost wholly on theory and observation, may be looked upon schematically as having the structure of a pyramid, all its accumulating subdivisions, even that of its first fundamental discipline, anatomy, meeting at the common Hippocratic point of the patient and his besetting ills.

All this, as is well known, came to be greatly altered when questions, by doubters, began to be asked about the meaning and causes of natural phenomena long regarded as an expression of divine will; and soon came the gradual infiltration into the medical art of a novel method of study—no new thing, to be sure, to those who read their Galen thoroughly—but when it led to the discovery that the blood did not simply ebb and flow as had been universally believed, Medicine was shaken to its very foundation.

Slowly but surely, this, the Baconian method of putting the intricate problems of the normal and disordered functions of the body to the test of experiment, made its way, receiving, as time went on, notable accelerations at the hands of such as Gilbert and Galvani, Boyle and Borelli, Mayow and Malpighi, Hunter and Haller, Majendie and Bernard and Pasteur and Cohnheim and a hoard of other originators, followers and imitators. Thus, one by one, the biological sciences based on experimentation were born of Medicine just as were the observational and philosophical sciences of an earlier day.

History repeats itself, and in the comparatively rapid development of a new country like our own, all that had taken place in the long-drawn-out development of Medicine we can see done over in miniature: the early priest-physician; the hereditary cure-mongers and bone-setters; belief in the supernatural, in magic and witchcraft; the art handed on by example from Aesculapian to apprentice; the gradual establishment of schools in which the entire field embraced by physic, surgery and sanitation, with a substratum of anatomy and immature chemistry, might even be covered by a faculty of one as it once was by Nathan Smith at Dartmouth. Even after the experimental method came to have its first exemplar of note in the person of William Beaumont, Medicine remained compact, its attention riveted on the care of the patient as definitely as in those Arabian times when all was comprised in the "Canon" of Avicenna.

But here, as in older countries, the experimental sciences were rapidly coming of age, and by the time this medical school opened its doors certain of these subjects had reached that stage of maturity they were accepted as preliminary essentials to a medical course, equal if not exceeding in importance even the study of anatomy, which from the days of Mundinus in Bologna had thus far held sway as the major premedical discipline.

And so a new educational structure came to be put together on lines quite different from the old pyramidal conception of Medicine at whose therapeutic apex sat doctor and patient. The structure may be said to have assumed a cuboidal form like two sets of boxed books on a shelf, the first set dealing separately with the three newly matured basal sciences, the second set with the three major and time-honoured clinical subjects of physic, surgery and child-bearing, while between the two sets was slipped in the book of pathology as intermediary in subject-matter.

It was a block system, all departments being on an

equality and more independent than interdependent. That each of them, as was natural enough, had an eye on the development of its particular branch of medical science or art and a progressively enlarging blind spot for its relation to the other branches, was probably more apparent to the student-pawn, as he was advanced from one block to another, than to the larger pieces constituting the faculty. To be sure, disadvantages of the system from the standpoint of educating practitioners of Medicine were largely offset in the early days of the School by the intimacy and ardour of a small band of enthusiastic workers, who would have made an educational success of any programme; but that is quite apart from this recital.

It is a matter of unwritten record that some twenty-five years ago, when on Osler's resignation the first break in the original faculty occurred, a revolutionary proposal was made by some of the junior members of the faculty that the structure of the School be reorganized in such a way that the existing departments could be brought together, Hippocratized as it were, by the creation of a *super*-professorship of MEDICINE. It was thought that influences could be brought to radiate through all departments, existing and future, so that, while retaining their former autonomy, they could nevertheless show a united front in attacking some of the greater problems in Medicine which equally concerned them all.

The suggestion, in short, was to pyramidalize the School under the leadership of the one person whose training, experience and personality eminently fitted him for such an apical position, and to whom all would have been eager to render allegiance. It was not solely because he was a pathologist and was thus already in contact with all other existing departments but more because of his broad vision and his wisdom. In our short-sighted and youthful enthusiasm it was felt that a like opportunity for a successful centralizing movement would be unlikely ever to occur again. There was one, and only one, serious difficulty that stood in the way of carrying the project through—the man chiefly concerned, when the matter was broached to him, for reasons of his own, refused the job.

So here and elsewhere during the twenty-five years that have since passed, the old system of progressively increasing decentralization has gone on with a successive splitting off from both preclinical and clinical departments of new groups many of which slowly have attained sufficient strength and dignity to be recognized as independent units.

More and more the preclinical chairs in most of our schools have come to be occupied by men whose scientific interests may be quite unrelated to anything that obviously has to do with Medicine, some of whom, indeed, confess to a feeling that by engaging in problems that have an evident bearing on the healing art they lose caste among their fellows. They have come to have their own societies, separate journals of publication, a scientific lingo foreign to other ears, and are rarely seen in meetings of medical practitioners, with whom they have wholly lost contact.

A distinguished physiologist recently, in commenting unfavourably on the cleavages which have taken place in physiology alone and on the impossibility of one man's keeping pace with the advances in its varied subdivisions, suggests that physiology as applied to Medicine might well enough be recognized as a science distinct from theoretical physiology, an admission, it would seem, that the subject—and the same is probably true no less of other sciences still clustered about Medicine—has outgrown its rôle as a strictly premedical discipline and is preparing for a life apart on the grounds of incompatibility of temperament.

So the independent science of Astronomy emerged from the days when diagnosis was largely a matter of prophecy wrapped up in divination and zodiacal horoscopes, of which we still have trace in the modified emblem of Jupiter that traditionally begins all our prescriptions; the judicial astrologer of old knew nothing of Millikan's cosmic rays but assumed the presence of something akin to them.

So an independent Botany has emerged from the search in all corners of the earth for medicinal herbs that conformed to the therapeutic law of signatures; our medical schools no longer have their physick garden, yet who knows what of value equal to digitalis may still be hidden in plants, were there modern Witherings to look for them?

So Zoology has grown from the search through the animal kingdom for ingredients with which prescriptions were once littered—the blood of the weasel, the droppings of the dove, the horn of the unicorn; and from the hyena alone, according to Pliny, come seventy-nine medicinal substances. We now smile at the idea of *Animalium natura et eorum medica utilitas* as a serious subject ancillary to Medicine, forgetting our present use of the oil of cod's liver, the tendons of the kangaroo, the thyroid of the sheep and much else for which posterity will similarly smile at us.

So modern Chemistry in the hands of Paracelsus began to take form out of earth, water, air and fire and the "black art" of ancient alchemy. So the science of dynamics is inseparably linked with a young medical student named Galileo and the story of the pulse. And so we may expect other sciences bred of Medicine whether essentially observational or experimental, to leave home when they have reached independent maturity. Thus, for better or for worse, the

gap between the medical sciences and clinic, always difficult to bridge, becomes ever widened as their application to diagnosis and the therapeutic art comes less and less to be emphasized in the course of their presentation to students of Medicine.

Slowly but surely, as a reaction to the block system, as described, each of the clinical departments has shown a tendency to become separately pyramidalized in such a way as independently to include in its own organization so much of the experimental sciences as is applicable to its particular interests and necessities —miniature medical schools complete in themselves, each striving for its separate institute, its own several laboratories for experimentation or diagnosis, its own library, separate organs of publication and so on. It would be entirely logical if a university department of medicine or of pediatrics or of psychiatry or neurology, or what you will, came to install its own operating plant and to direct its own surgical therapeutics; or, on the other hand, if out of surgery there should develop an independent school with a substratum representative of all other departments, clinical and preclinical, teaching its own applied anatomy and physiology and chemistry and pathology, similar in organization to that remarkable institution in Rochester, Minnesota, a product of our own time.

The only check to the successive formation of these independent institutes, within our medical schools as now organized, is the capacity of the university purse; the only ties that remain in most places to bind separating departments together are the students, whom as yet they share in common and who for long are at a loss to know what Medicine is all about—its emblematic serpent having become so hydra-headed. Were they not a far more docile body than in those Bolognese days when students elected their own rectors, they would, I fear, pick up their more favoured teachers and swarm in a body to set up a "studium" of their own liking in some convenient new-found place.

And meanwhile, almost too new to mention, still another fission, the entering wedge to which was driven by Pettenkofer a short fifty years ago, has occurred before our very eyes with the development of separate schools of hygiene for the training of public-health officials—schools in which mass prevention in place of individual cure is properly emphasized. It is a movement grown out of that revolutionary maxim that the health of the people is the supreme law; it assures a much safer and more pleasant world to live in; it has greatly increased the expectancy of life and may even serve to prolong the span once allotted to us by the Psalmist. But owing to it, just so many more people will remain longer alive to need at some time or other the personal ministrations of a modern Sydenham for their "vapours," a Cadogan for their diet, a von Graefe for their sight, a Bright for their kidneys and a Lister for much else.

What possible relation, you may well ask, does this rapidly moving account of the cleavages in Medicine, past and apparently on the way, have to the dedication of this library and its inseparable association with the establishment of a chair of the History of Medicine? Will this foundation merely mean still another group of specialists having their own societies, organs of publication, separate places of meeting, separate congresses, national and international, who will also incline to hold aloof from the army of doctors made and in the making? Without lessening the opportunity and encouragement for historical and bibliographical research, on the part of those rare and highly gifted persons capable of it, is there not something far more important for Medicine that can radiate from here?

In the modern development of the physician into a scientist, have we not lost something precious that may without risk of pedantry be brought back to Medicine? Not only has the art of healing, *die Heilkunst,* come more and more to be lost sight of as the doctor arrives at his diagnosis in the laboratory rather than at the bedside, but less and less does he care to be reminded that poetry, history, rhetoric and the humanities once had close kinship with natural philosophy when the *Doctores Medicinae* took the leadership among the *Artisti.*

The doctor, widely speaking, is woefully ignorant of the history of his profession, indeed regards bookishness as a form of swank. Some years ago my friend, E. C. Streeter, and I requisitioned a booth at one of the Atlantic City meetings of the American Medical Association in which we displayed a collection of books, pictures and so on pertaining to André Vesal, known as the father of modern anatomy. Alongside of us were stalls in which infant foods, the latest thing in hygienic corsets, the newest tooth powders, the latest surgical instruments, novel electrical appliances, X-ray machines, lighting devices and so on were being competitively displayed. Streeter was to be on hand to show our wares in the mornings; I in the afternoons. In large letters the display was labeled: VESALIAN EXHIBIT. "How did it go?" I asked my companion eagerly at lunch on the first day. "Was there a large crowd; did you need help?" "Well," said he, "one man stopped long enough to inquire if I had any samples, and when I politely asked to what he referred, he pointed to our sign and said rather tartly, 'Samples of Vaseline, of course.'"

This story, a little overdrawn perhaps, is reminiscent of the common belief that the discovery of listerine was what brought Lister fame. A tube of vase-

line would conceivably have been of more practical use to the enquiring doctor; but I am not so sure of that, and our mistake lay in not having a sample of our exhibit to hand out. It might have made a different man of him.

"I have addressed myself to the Muses," said Gabriel Naudé, "without being too much enamour'd of them; I was pleased with my Studies, but not too addicted to them. . . . Pedantry might have gained something upon my Behaviour and Carriage, during seven or eight Years that I staid in the Colleges, but I can assure myself that it obtained no Advantage over my Spirit." Can something of this old-time spirit of scholarship be recaptured, and is it in any way incompatible with the spirit of research? Can separating departments again be brought together by the tie of a library shared in common, and by the renewed consciousness of a common ancestry and a noble history? Certainly could this happen anywhere, this place, which has been the proving ground of so many experiments in medical education, would seem the most favourable.

A medical historian and one of the world's great bibliographers played a highly important rôle when this medical school was in the making. But curiously enough, that modern Naudé, John Shaw Billings, when his plans for the hospital were drawn, made scant provision for a library. His mind was evidently on larger things—on the general principles of organization and construction of a place where, as he expressed it, the student's knowledge was "not to be acquired from text-books or lectures, but from observation, experiment and personal experience." He doubtless took it for granted that a library would come into being, as it soon did, for books were essential to the activity of that closely knit group of young men, all on the sunny side of forty, who first gathered here.

The story of those days can be easily reconstructed from those incomparable early volumes of the hospital *Bulletin*, a new thing in American medical journalism, so ably directed by that man of many parts, Henry M. Hurd, historian, editor, psychiatrist and hospital administrator, all packed into one frail but scholarly body. The footprints of Osler are seen in the early establishment of a Journal Club which met, each Thursday afternoon in the convenient room soon set apart for a library, to review and discuss articles from the contemporary literature relating to the day's work. And next came the formation of a Hospital Medical Society which, according to an announcement in the first issue of the *Bulletin*, was to gather under the presidency of W. H. Welch on the first and third Mondays of each month.

For one of the early meetings of this society Dr. Billings brought over from Washington forty-four carefully selected volumes, ranging from a fifteenth century manuscript of Rogerius Parmensis down to the first edition of Jenner's "Inquiry," which served to illustrate the discourse he then gave on rare medical books. A surprising number of that early group showed an interest in medical history and we find ere long in the *Bulletin* this announcement:

> The first meeting to organize the Johns Hopkins Hospital Historical Club was called to order by Dr. Osler in the Hospital Library, Monday evening, November 10th, 1890, at 8 o'clock, 30 gentlemen present. Dr. Welch was elected president and Dr. Reese secretary. Dr. Welch made brief introductory remarks to show the value of historical studies to the physician. . . . He presented several histories of medicine and commented upon the merits of the various historians.

The society soon launched itself on a methodical survey of medical history that began bravely enough with a study of the Hippocratic writings. But the next year in the effort to plumb the depths of Galen the Club nearly foundered, proving the wisdom of Garrison's advice that the beginner should back up into the subject rather than start out with its obscure origins. And so the ambitious programme came to be abandoned, the often delightful though desultory papers and essays that characterized the monthly meetings of later days being substituted for it.

Dr. Billings meanwhile had been coming over from Washington to deliver two courses of lectures—and prophetic were his chosen topics. One was on the subject of hygiene, which after an interval of some thirty years attained its majority in the establishment of the great institute across the way. The other course of lectures was on medical history, a subject which now, in turn, will have full opportunity for development under the fostering care of the same person who is reported as having said nigh forty years ago what he doubtless still believes, that "the study of the history of the various medical doctrines broadens a physician's view and liberalizes his conception of his profession."

Dr. Billings' afternoon exercises in those early days, based presumably on his recently delivered Lowell lectures, were, I grieve to say, but slimly attended. Even with his rare gifts it was almost too heavy an historical meal for the undergraduate, and the members of the residential staff had come to find themselves under so heavy a burden of bedside responsibility that their attendance was prevented. So when Billings moved to Philadelphia on his retirement from the Surgeon-General's Library after the completion of the first series of the Index Catalogue, the formal lectures were brought to an end.

They came, however, to be replaced by something far more palatable to the students—the Oslerian method of slowly but surely arousing an historical ap-

petite by the proper touch in each exercise upon the historical bearings of the subject under discussion, whatever it might be,—an eponymic question asked, the original source-books passed around, a paragraph read, a picture shown or an incident related. In this way, by the process of repeated inoculations, many students who unquestionably would have sidestepped a formal course of lectures became unconsciously impregnated with something much more valuable to them in the long run than the acquirement of just a few more facts concerning diagnosis and treatment.

It will be apparent, I hope, from all that has gone before, what is the burden of my theme—a library made useful not as a passive but an active force; one that is "not vocational but cultural, not final but initiative"; one that will serve as a common meeting-ground where the different streams of knowledge may coalesce; one where an interest in the history of our great profession will so flourish as to permeate into all departments of a much-divided school; a place from which the appeal of scholarship free from pedantism will radiate to long generations of future students—a place, in short, where Medicine, the foster-mother of the sciences, once more in close contact with her whole family will imbue them all with the spirit of that ancient phrase, "Where there is love of humanity, there will be love of the profession."

As was true a quarter of a century ago, so is it no less true now that there is but one man who by universal accord has the qualities of a Conciliator needed to bring these possibilities to fruition—a man whose services to his profession and to this School are apotheosized by this building—a man who can see the reasons for things while most of us can but look for the things themselves, and who is aware "that as our own conquests could not have been won without those which our fathers won, so must the future forever rely for help upon the past."

He might have asked to be allowed to approach in quiet the evening of life, content with the many successful parts he has already played, but this was not his way. Few knew how he has laboured during the first sabbatical year he has ever taken, what hours he has spent in cramped, dark and unventilated places personally to select and bring together what are to be the tools of this new institute that bears his name, never a day without work, never a conversation without its direction on something that mattered. In accepting this new and important rôle he stands, to paraphrase some well-known lines, upon the summit of his years: Not bowed beneath their weight, with feet firm planted and soul undaunted, he stands and contemplates what time has wrought, and trembles not for what was, is, or is to be.

THE PLACE OF GEOLOGY AMONG THE SCIENCES[1]

By Dr. JOHN C. MERRIAM

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IN the early specialization of natural science it seemed relatively easy to give sharp definition to the boundaries of each subject. To-day, as we look upon the continuity of the universe in time and space and action the aspects of knowledge which we call the sciences represent in considerable measure only different points of view.

Seen as a part of the general scheme of things, each so-called science is the point of focus upon which other knowledge is concentrated for a particular purpose. Looking out from the place at which these rays converge it might appear that each subject comprises all the others. So physics may seem the whole of the universe, including life, mankind and human activities. Anthropology, described as man and his works, could compass everything from physics to religion.

Geology, as representing the earth, its structure, its activities, its history, touches science in all phases. It ranges through the physics and chemistry of the earth, its physico-astronomical origin, its expression of current activity, changes of form and face, history of climate and the biological story read from the geological record. Even our basis of judgment regarding the nature of man and his possibilities for the future is indissolubly bound in with the geological story. And yet geology is not all these subjects. It is only that aspect of each expressed in the composition, origin, structure, activities and history of a particular astronomical unit—the earth—upon which we happen to live.

Apart from the centering of attention upon this particular earth, geology possesses marked individuality as a mode of thought, or as the consideration of a special aspect of natural relations, through its expression of the element of time and the significance of movement through it. Lyell described geology as "the science which investigates the successive changes that have taken place in the organic and inorganic kingdoms of nature." It stands out clearly among the sciences as the symbol of time and development. In

[1] Read at the fiftieth anniversary celebration of the United States Geological Survey, Washington, D. C., March 21, 1929.

no other phase of knowledge is there a comparable record of events in their chronological order, laid together in such manner that the processes or movements may be made the subject of scientific analysis. In no other science is there comparable illustration of the processes of change or movement or evolution as related to or framed in time.

Important as the developmental or evolutional view has become in science, in general we interpret the materials most readily through the historical process. So in biological evolution the close resemblance in structure of certain birds and reptiles suggests common origin. One assumes a history which would carry the two branches back to remote time where common ancestors might be found. But geology, with its fourth dimension of time, shows us the succession of ages with actual materials left from each in the order of appearance. In ancient mud deposits of south Germany preserving with almost miraculous fidelity the intricate tracing of the insect's wing and the form of the jellyfish, the relationship of bird to reptile is made real by that strange creature, the Archaeopteryx, with long, feathered lizard tail, fingered wings and toothed reptilian jaws, a veritable missing link.

The historical element of geology corresponds to that of archeology in that it is of the order of inference which does not leave room for reasonable doubt. Fragmentary as the remains may be, they are the residuals of materials themselves, and the sequence in which they appear represents the measure of time and of change.

The results in use of this method of examination in terms of time are of incalculable significance to all science and to our thinking as it concerns human problems.

No discussion of structure or history of the earth approaches completeness unless there be included in it an acceptable statement of the origin of the planet in terms of cosmic physics. The attempt to trace the story back to its beginnings is not mere expression of idle curiosity. In the physics and astrophysics involved in the initial development of the earth lie important elements relating themselves directly to the processes and problems of geology as we meet them to-day. Basic in consideration of laws dominant in geological activity must always be that chapter in the story of the earth centering upon studies such as those of Chamberlin, indicating that our planet owes its origin to approach of another star, bringing about partial disruption of the sun and expulsion of a great mass which ultimately formed the earth. In many aspects this phase of geology is physics; in others it is astronomy.

Again, in the story of earth activities illustrated in crustal movement, or in what might be called the physiological process, the principles of physics expressed and interpreted through mathematics become so fully dominant that at times they seem in importance to overshadow the process considered in terms of geology. But we may not forget that even in these investigations the elements of time and sequence and the mode of change become dominant in the synthesis of data which furnishes the ultimate story of the earth.

In a long generation behind us the geological story of life has attained a relatively high level of human interest, suggesting as it does the principle of change or development or evolution through the ages. The nature of the movement, and the process as we see it, might have been worked out through examination of the expression of life in its many kinds or species, or the relation of this differentiation to distribution, or the differentiation and distribution as related to the embryological history of the individual. Yet, with all the data available, the most clearly indisputable evidence of the process which we call evolution is that presented by the record in the rocks.

The aid of geology to biology has been fully repaid by biology through its furnishing of the unreversed paleontological sequence which has been a critical factor in working out the geological time scale for the world. Geological and paleontological correlation, as means for furnishing a complete and fully interpretable record, still presents one of the most important problems of research.

Among the outstanding biological questions toward solution of which geology makes contribution are those concerning the origin and history of man. One of the most important ideas in the range of knowledge is the suggestion that through the ages human kind has tended definitely to widen its opportunity and increase its capacity for understanding. This principle in history so highly valued to-day is made possible largely through evidence from the geological record. One of the elements of especial interest in the geological story lies in the suggestion that of the total record of human life probably more than 99 per cent comes well within the region for which the geologist is the accepted authority.

The place of research in this particular field of geological history may well rank among the leading possibilities of science. While the investigator rests with assurance upon evidence that to him seems adequate, the great bulk of data still to be expected from research would have enormous influence in making clear to all mankind the idea of change and progress in the longer stretch of history.

Considered from one point of view, we may think of the heritage of man as represented in three elements—the sun, the earth and our machinery for use and development of knowledge. The earth with its story is the objective of the geologist. Upon it must concentrate the most intense study that human intelligence can plan. By definition the geologist becomes conservator of great natural resources upon which life and the future of mankind will in large measure depend. Conservation is not *disuse*—but *which* use shall we permit. Within its program research may well come to have the highest place, with premium placed not alone on discovery of the situation in which a substance is found. The way to use the material to full advantage will also be recognized as of enormous human value.

Recently we began to discover that certain of our biological resources which might soon vanish may be replaced. The reproduction or the synthesis of that which forms the solid earth we have yet to learn. Geology must draw on all knowledge to build its broad foundation even wider. So chemistry and physics and geology will unite to locate and to devise the economic exploitation and the best human use of a wide range of substances of inestimable value to man. In another direction geology and agriculture see the study of erosion and sedimentation as an essential phase of research relating to future use of the arable lands of the world.

And, last of all, among the sciences geology bears responsibility as teacher in a field which is always spread before us in daily life. To some the earth's face never ceases to be flat, and so flat-minded they remain. To others the hills and valleys, through the story of history and building and beauty they present, open a vision of realities which lifts us far above the pettiness of things which in the routine of the day may tend to trouble us.

OBITUARY

TOSHIKI MORISHITA

ON July 2, 1929, occurred the death of Dr. T. Morishita, who for two and a half years had been connected with the Yale University department of bacteriology as an assistant and research student engaged in a study of dental bacteriology and pathology. He had been suffering for several weeks from a respiratory disturbance which did not appear serious and which until a few days before his death promised complete recovery.

Dr. Morishita was born in Japan in 1896. He obtained his early education in the Tono High School, and in 1914 entered Tokyo Dental College, from which he graduated in 1918. For several years after graduation he practiced dentistry in Japan. His yearning for scientific research related to problems of dental decay became a passion, and in 1922 he relinquished his profession and sailed for America to prepare himself further for scientific dental research. He entered the Toronto Dental College, receiving the degree of D.D.S. in due course.

After having engaged in special research work in McGill and Harvard Universities, where he further laid an excellent foundation for his work as an investigator, he became intimately associated with the division of general bacteriology of Yale University, where for over two years he prosecuted his research feverishly and without serious interruption until his untimely death.

Dr. Morishita's chief interest was centered in natural dental decay, and more particularly the influence of high acid producing and tolerating (aciduric) organisms which he found to be so intimately connected with initial and progressive caries. The first report of this painstaking work appeared in the *Journal of Bacteriology* for September, 1929. It was the author's intention to follow this paper with four or five contributions, for which sufficient data were rapidly accumulating. These records are now in the possession of the laboratory, and it is hoped that they may be built up into at least one or two additional manuscripts and published under Dr. Morishita's name.

Dr. Morishita was particularly well qualified as an investigator in the field of scientific dental research. He was brilliant in the conception and execution of his complex problem. He was ceaseless in his devotion to his work, and had attained a degree of success in his chosen field which promised a bright future.

LEO F. RETTGER

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RECENT DEATHS

DR. EDWIN W. ALLEN, chief of the office of experimental stations of the U. S. Department of Agriculture, died from heart disease on November 11. Dr. Allen was in Chicago to attend the meeting of the Association of Land Grant Colleges and Universities. He was to have given a memorial address on his predecessor, the late Dr. Alfred C. True. Dr. Allen, who was born in 1864, entered the service of the Department of Agriculture in 1890 and was assistant director of the office of experiment stations from 1893 to 1915, when he became chief of the office.

JAMES WALKER MCCOLLOCH, professor of entomology, Kansas State Agricultural College died on November 11. Professor R. L. Parker writes: "Professor McColloch was born in Anthony, Kansas, April 14, 1889. In 1912 he received the B.S. degree from the Kansas State Agricultural College, and in 1923 received the M.S. degree from the same institution. He began work as an assistant entomologist at the Kansas State Agricultural College in 1910, was associate entomologist of the Kansas Agricultural Experiment Station in 1918 and was raised to the rank of professor in 1925. In his passing, entomologists are mourning the loss of one of the outstanding workers in that science. Through the publication of papers, bulletins and circulars, he became known as an authority on the chinch bug, Hessian fly, wireworms, white grubs and other subterranean insects. He was a member of several scientific organizations; namely, the American Association for the Advancement of Science, the American Association of Economic Entomologists, the Entomological Society of America, the Ecological Society of America, the Kansas Academy of Science, the Kansas Entomological Society, Phi Kappa Phi, Gamma Sigma Delta, Alpha Zeta and Sigma Xi. At the time of his death he was editor of the *Journal* of the Kansas Entomological Society and one of the sectional editors of *Biological Abstracts*."

A CORRESPONDENT writes: "Dr. Frederick Tuckerman died at Amherst, Massachusetts, November 8 at the age of seventy-two years. He was graduated from the Massachusetts Agricultural College in 1878, received the degree of M.D. from Harvard University in 1882, studied in London, Berlin and Heidelberg, receiving the degree of Ph.D. from the latter institution in 1894. He was a lecturer on anatomy and physiology, a writer on scientific and historical subjects, a member of many scientific and other societies, and a gentleman of culture and learning."

THE death is announced of Professor Carlo Francioni, director of the pediatric clinic of the University of Bologna, at the age of fifty-two years.

SCIENTIFIC EVENTS

THE CAMBRIDGE LOW TEMPERATURE RESEARCH STATION

A RECENT gift from the British Empire Marketing Board has substantially extended the low temperature research station at Cambridge which, under the Department of Scientific and Industrial Research, is carrying on work of importance to the future of trade in food supplies. Sir William Hardy, the director of the station, recently made a statement in regard to its work to a special correspondent of the London *Times*, according to which the older part of the building has been in use for about eight years. The site was given by the University of Cambridge, which is actively assisting the work in other ways through its own physiological, botanical and chemical laboratories. The work of the low temperature station is now concerned exclusively with meat and fruit. Formerly it dealt also with fish, but an inland station can not do such work satisfactorily, and the Empire Marketing Board is therefore helping to establish a station for the purpose at Aberdeen.

The function of the station here is delimited in another direction also. It may be called upon to decide what conditions of temperature and so forth are needed in the shipment of supplies from oversea countries, but, these conditions having been theoretically determined in the Cambridge laboratories, the provision of them on board ship becomes an engineering problem, and this side of the task devolves on the National Physical Laboratory at Teddington.

The Low Temperature Station is lavishly equipped with cold-storage plant and other apparatus, in which products under examination may be kept at any required temperature and under closely regulated conditions in other respects. Any temperature can be produced between minus 30 deg. Centigrade and plus 40 deg., and kept constant to a hundredth of a degree. Sir William Hardy explained that it takes some months in the first instance to extract all the heat from the installation and get the conditions steady. The refrigerating engines are kept continuously at work. They had been running without a pause for eight years until this summer, when they were stopped to allow the new installation to be linked up with the older plant.

On two occasions members of the staff have been sent out to Australia to return with cargoes and conduct investigations during the voyage. A survey is starting at present of conditions in ships bringing foodstuffs from New Zealand, and a similar survey has been in progress for the last two years on British trawlers. Municipal authorities and private fruit dealers also may bring their problems to the station. A dealer may write to ask why all his pears are turning rotten this year. In such a case the director will send one of his staff to make an investigation on the spot. The station has also a small canning plant of its own for research into the separate problems of this growing industry.

LAND FOR FOREST RESERVATIONS

THE acquisition by the federal government of a total of 85,195 acres of land for national forest purposes was approved recently by the National Forest

Reservation Commission at its first meeting of the current fiscal year. The purchase program involves eleven units and a total obligation of $229,506.82 with an average price of $2.69 per acre.

The areas approved for purchase are located in purchase units already established in eight states. When acquired, they will be placed under national forest administration by the Forest Service of the U. S. Department of Agriculture, to be managed for permanent timber production, watershed protection and other public forest uses. Some of the lands contain young timber growth which, with adequate fire protection and the right kind of management, will develop into good timber stands. Certain areas have been so badly denuded by cutting and fire that they will have to be replanted.

THE late Secretary of War Good was chairman of the commission; other members are Secretary of the Interior Wilbur, Secretary of Agriculture Hyde, Senators Keyes of New Hampshire and Harris of Georgia, and Representatives Hawley of Oregon and Aswell of Louisiana. John E. Burch is secretary.

The purchase program approved by the commission is as follows:

Purchase Unit	*Acres*	*Obligation*
Alabama, Ala.	3,483	$ 20,639.00
Catahoula, La.	33,916	123,583.00
Cherokee, Ga.-Tenn.	408	1,224.00
Huron, Mich.	5,096	9,807.73
Keweenaw, Mich.	3,422	7,425.77
Mackinac, Mich.	17,626	26,441.05
Marquette, Mich.	75	111.84
Moquah, Wis.	13,236	18,483.81
Ouachita, Ark.	980	2,836.00
Ozark, Ark.	2,912	12,370.35
Superior, Minn.	4,041	6,484.27

THE NEW YORK ASSOCIATION OF BIOLOGY TEACHERS

(1) THE New York Association of Biology Teachers announces the following program of addresses for its first six monthly meetings of 1929–1930.

September: Dr. Benjamin Harrow, "Amino Acids and Vitamins."
October: Dr. A. B. Stout, "Sterilities in Plants."
November: Dr. L. O. Howard, "We must know more about Insects."
December: Dr. Gary N. Calkins, "The Nucleus."
January: Dr. Lee Crandall, "Explorations in New Guinea."
February: Dr. Knight Dunlap, "Present Views regarding the Function of the Brain."

The meetings ordinarily are held on the third Friday evening of each month at the American Museum of Natural History. In addition, the organization will hold two other regular evening meetings, including a joint science dinner with the teachers of physics and chemistry, several "field" trips, including four to the Brooklyn Botanic Garden for a series of demonstrations of work in plant breeding and pathology: sorghum, corn genetics; variation of the Boston fern; breeding for immunity in grains; cabbage types; etc.

(2) A report on science sequence in high schools was prepared by a committee of chairmen of biology departments (high schools) of New York City as a basis for discussion and possible action. The principal points stressed are two: the importance of extending effective science instruction downward into the first two years of the junior high and last two of the elementary school systems; and second, the urgent need of developing high-school courses in chemistry and physics which shall function in the lives of the pupils taking them, independently of preparation for possible later courses in higher grades of the same sciences.

(3) Readers of SCIENCE interested in obtaining a copy of a survey of the secondary science situation in New York City public high schools (Tildsley, "Science as a Way of Life," Bulletin of High Points in the Work of the High Schools of New York City, October, 1928) may do so by sending six cents postage to Dr. R. C. Benedict, Haaren High School, 10th Ave. and 59th St., New York City.

Dr. Benedict, who has sent to SCIENCE the information given above, reports that he has checked over the recently issued volume of Proceedings of the American Association for the Advancement of Science and finds that 125 members of the New York Association of Biology Teachers are members of the association.

PERMANENT SCIENCE FUND

A NEW fund the income of which will be available for advancing scientific research has recently been established in a manner sufficiently novel to be of interest to scientific men and to those who may contemplate gifts to science.

By an agreement and declaration of trust made September 5, 1928, the Boston Safe Deposit and Trust Company has agreed to receive and hold in trust gifts or bequests which shall be made to it as trustee of the Permanent Science Fund. The financial administration of the fund will be by the Boston Safe Deposit and Trust Company. The income will be paid over to the American Academy of Arts and Sciences which has undertaken to disburse the money in the aid of scientific research.

These simple arrangements should provide a permanent and experienced financial management of the principal or capital account with a permanent and competent scientific management of the expenditure of the income, both of which should be readily adaptable to changes in the investment or scientific situation.

The amount currently available for disbursement is estimated at about $2,700 a year, and may be expected to increase as benefactors of science come to appreciate the advantages of the Permanent Science Fund as a depository of gifts.

Applications for grants-in-aid should be addressed to the Committee on the Permanent Science Fund, American Academy of Arts and Sciences, 28 Newbury Street, Boston, Mass.

EDWIN B. WILSON

PSYCHIATRY AND MENTAL HYGIENE IN YALE SCHOOL OF MEDICINE

THE appointment of Dr. Eugen Kahn, of Munich, Germany, as professor of psychiatry and mental hygiene in the Yale School of Medicine is announced by President James Rowland Angell.

Dr. Kahn studied at Heidelberg, Munich and Berlin, where he interested himself primarily in the fundamental sciences which deal with the nervous system. For many years he worked under the late Emil Kraeplin, the noted psychiatrist, in whose honor the Rockefeller Foundation in 1928 presented a building to the German Psychiatric Research Institute in Munich, a unit of the Kaiser Wilhelm Institut, recognized as the foremost organization in that country for the promotion of scientific research. When Dr. Kraeplin decided in 1925 to give his whole time to the Psychiatric Institute, which he had founded, he left the active direction of the psychiatric and nerve clinic of the University of Munich to Dr. Kahn, who has since been professor in that clinic.

Dr. Kahn is among the first to be appointed in connection with the program for developing the study of psychiatry and mental hygiene at Yale. Early in 1929 the Rockefeller Foundation pledged $100,000 a year for ten years to develop this program, and in addition provided the funds for the Institute of Human Relations building, now under construction, in which the department will be housed. For the development of the mental hygiene aspects of the program the Commonwealth Fund is making an annual allowance of $50,000.

Dr. Kahn recently spent several weeks in New Haven studying the plans and will return in March to assist in equipping the institute building for the work in psychiatry. The building will have facilities for the care of fifty individuals who will be studied from the point of view of their mental economy. Some of these will be of inferior mentality while others will be average and superior. The keynote of the work will be the prevention of mental disease by tracing it in all its forms to the contributing factors and origins.

Associated with Dr. Kahn will be Dr. Lloyd J. Thompson as resident and chief of staff; Dr. Edgar Van Norman Emery, former chief of the Los Angeles child guidance clinic; Dr. C. C. Fry, who is consultant and adviser for university students, and others to represent the varied interests of the institute.

According to Dean M. C. Winternitz, of the Yale School of Medicine, the work in the department of psychiatry and mental hygiene will rest upon the fundamental fields of neuro-physiology, neuro-anatomy and neuro-pathology. These branches are being constantly strengthened by the addition of personnel and funds. In the clinical field the new department will be closely associated with the clinical departments now in existence in surgery, internal medicine, diseases of women and diseases of children.

SCIENTIFIC NOTES AND NEWS

AN Associated Press dispatch from Stockholm reports that the Nobel prize in physics for 1928 has been awarded to Professor Owen W. Richardson, King's College, London. Dr. Richardson was professor at Princeton University from 1906 to 1914. The prize in physics for 1929 has been awarded to the Duc de Broglie, of Paris. The prize in chemistry has been divided between Dr. Arthur Harden, head of the biochemical department of the Lister Institute and professor of biochemistry in the University of London, and Dr. Hans von Euler, professor of biochemistry in the University of Upsala. As already announced in SCIENCE the prize in medicine has been divided between Dr. Frederick Gowland Hopkins, professor of biochemistry at the University of Cambridge, and Dr. C. Eijkmann, professor of hygiene and legal medicine at the University of Utrecht.

ACCORDING to the *Journal* of the American Medical Association the French government has awarded a gold medal in honor of the researches made on infectious diseases by the late Dr. Hideyo Noguchi, of the Rockefeller Institute for Medical Research, who died in Africa during his studies on yellow fever. The medal was given to his nephew on August 26, through the department of foreign affairs.

DR. FLORENCE RENA SABIN, member of the Rockefeller Institute for Medical Research since 1925 and

previously professor of histology in the Johns Hopkins Medical School, has been awarded the *Pictorial Review* prize for the most distinguished contribution by an American woman to American life in art, letters or science. Dr. Sabin will receive the award of $5,000 at a luncheon to be given in her honor.

THE University of Strasbourg has conferred an honorary doctorate on Professor Harvey Cushing, Moseley professor of surgery in the Harvard Medical School and surgeon-in-chief at the Peter Bent Brigham Hospital.

DR. MAX RUBNER, professor of hygiene and physiology in the University of Berlin, has been elected an honorary member of the Physiological Society, London.

THOMAS A. EDISON was the guest of honor at the one hundred and sixty-first annual dinner of the New York State Chamber of Commerce in the Hotel Astor on November 21. A portrait was unveiled which later will be placed in the gallery of the chamber in its building. Among the speakers were Dr. Benjamin M. Anderson, Jr., economist of the Chase National Bank, and Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research.

GULIAN PICKERING RIXFORD applied on September 21 for retirement from his position of plant physiologist in the office of horticultural crops and diseases, Bureau of Plant Industry, on the date on which he celebrated his ninety-first birthday. Mr. Rixford entered the service of the United States Department of Agriculture in 1908 in connection with the distribution of Smyrna figs and caprifigs, the introduction of the pistache nut into commercial culture, and the study of miscellaneous subtropical crop plants. He was then seventy years of age, but his extraordinary physical vigor is illustrated by the fact that in his twenty-one years of service in the office he has taken very little annual leave and practically no sick leave until the past summer when a field trip during one of the intensely hot spells of weather proved a little too much for his strength.

Nature reports that at the annual meeting of the Royal Society of Edinburgh, held on October 28, the following officers were elected: *President:* Professor Sir E. A. Sharpey-Schafer; *Vice-presidents:* Emeritus Professor W. C. M'Intosh, Professor Sir Robert W. Philip, Professor J. Graham Kerr, Professor W. Wright Smith, Professor Francis G. Baily, Professor T. J. Jehu; *General Secretary:* Professor R. A. Sampson; *Secretaries to Ordinary Meetings:* Professor C. G. Darwin and Dr. James Ritchie; *Treasurer:* Dr. James Watt; *Curator of Library and Museum:* Professor D'Arcy W. Thompson; *Councillors:* Professor J. H. Ashworth, Professor E. Taylor Jones, Dr. J. B. Clark, Professor F. A. E. Crew, Professor J. Montagu F. Drummond, Mr. D. A. Stevenson, Professor H. W. Turnbull, Emeritus Professor Sir James Walker, Dr. James Drever, Mr. A. H. R. Goldie, Dr. R. A. Houstoun, and the Honorable Lord Sands.

DR. MAX MASON, director of the natural science division of the Rockefeller Foundation, and formerly president of the University of Chicago, has been elected president of the Rockefeller Foundation. He will succeed Dr. George E. Vincent, who has been president of the foundation for the last twelve years.

DR. HARVEY N. DAVIS, president of Stevens Institute of Technology, has been appointed a manager of The American Society of Mechanical Engineers to fill the unexpired term of Mr. L. B. McMillan, who was killed on August 9 last in an airplane accident. Mr. Robert M. Gates has been designated to take Mr. McMillan's place as council representative on the finance committee of the society and also on the executive committee of the council.

DR. EATON M. MACKAY, formerly on the staff of Stanford University Medical School, will be in charge of the new physiological and chemical laboratory of the Scripps Metabolic Clinic, La Jolla, California.

THE *Journal* of the American Medical Association reports that Dr. Leverett D. Bristol, who, for the last six years has been director of health demonstrations for the Milbank Memorial Fund, has been appointed health director of the American Telephone and Telegraph Company with headquarters in New York. Recently, Dr. Bristol made a health survey of the Bell Telephone System in the United States and Canada. He was formerly commissioner of health in the State of Maine and professor of public health at the University of Minnesota.

DR. C. V. DRYSDALE, superintendent of the British Admiralty Research Laboratory, has been appointed director of the scientific research and experiments department of the admiralty. He succeeds Dr. F. E. Smith, who has taken up the appointment of secretary to the department of scientific and industrial research.

IN recognition of the value of a study of pure psychology to clinical psychiatry a department of psychology, under the directorship of Dr. James Drever, reader in psychology at the University of Edinburgh, has been instituted in connection with the Jordanburn Nerve Hospital; Dr. Drever will be assisted by Dr. Mary Collins and Dr. Fairbairn.

DR. P. H. ROLFS, who has been in Brazil for eight years, establishing an agricultural college for the state of Minas Geraes, on the North American plan, has recently returned after a vacation in the United States. He is now "consultor technico de agricultura"

for the same state, and will continue to reside in Viçosa. As already reported Dr. Rolfs has returned to Brazil. He was accompanied by three professors for the agricultural college which he established in Minas. A. O. Rhoad, B.S. (Penn. State), M.S. (Cornell), will have charge of the department of animal husbandry; A. S. Muller, B.S. (Cornell), will establish a department of plant pathology, and Mr. E. J. Hambleton, B.S. (Ohio University), M.S. (Cornell), will establish the work in entomology.

DR. K. LARK-HOROVITZ, director of the laboratory of physics of Purdue University, has returned from a three-months' trip to Europe, where he studied research problems of glass and its manufacture. He visited leading glass factories in Germany, England, Austria, Czecho-Slovakia, Hungary, Holland and France, and established connection between the research work on glass and refractories being conducted by the Purdue laboratory of physics.

GILBERT OTTLEY and H. E. Anthony have sailed for Mollendo, Peru, on an expedition for the American Museum of Natural History. This expedition is made possible through the financial assistance of Mr. Ottley. Mr. Anthony, curator of the department of mammals, is in charge of the expedition, and Mr. Ottley will assist in making collections of mammals, taking photographs and recording observations. The primary purpose of the trip is to make a biological reconnaissance through southern Peru, Bolivia, Chile, Argentina, Paraguay, Uruguay and southern Brazil.

EX-GOVERNOR GIFFORD PINCHOT and his party have returned after a seven-months' cruise on the yacht *Mary Pinchot*. Grand Cayman, Swan Island, Old Providence and St. Andrew were visited in the Caribbean, and in the Pacific, Cocos Island, the Galapagos, Marquesas and Tuamotus. Extensive collections of birds were made by Dr. A. K. Fisher, and of mollusks by Dr. Pilsbry. These will be studied at the National Museum and the Academy of Natural Sciences of Philadelphia. Numerous porpoises and reptiles were taken, and Mr. Pinchot secured valuable notes, material and photographs of the little known mantas or giant rays of the Galapagos and Marquesas.

PROFESSOR DOUGLAS JOHNSON, of Columbia University, who is spending a sabbatical year in geologic and geographic studies abroad, recently visited South Africa and Australia. In South Africa he participated in the International Geological Congress, presenting a paper on "The Geomorphic Aspect of Rift Valleys" at the Pretoria sessions, and delivered a public lecture on wave phenomena before the British Association at Cape Town. In Australia he spent several days in examining the coastal features in the vicinity of Perth, then crossed the continent by rail with stops at Adelaide and Melbourne to see coastal and other phenomena of special interest. A four days' motor trip from Melbourne to Sydney gave opportunity to examine reported evidences of sea-level changes on the south-east coast. In Sydney Professor and Mrs. Johnson were guests of the state government on excursions to the Jenolan Caves and the Newcastle Coast, and on an inspection of Sydney harbor with a party of local geologists on the government launch *Premier*, as part of a program of excursions arranged by Professor Sir Edgworth David. On October 14 Professor Johnson gave an address on "Studies of Shoreline Physiography" at the rooms of the Linnaean Society in Sydney.

A COMMITTEE of five has been appointed by the American Association of Colleges of Pharmacy to consider a national educational policy with regard to the new four-year curriculum advocated by leading pharmacists of America. The members of the committee are Dr. Townes R. Leigh, dean of the University of Florida College of Pharmacy; Dr. Julius A. Koch, dean of the Pittsburgh College of Pharmacy; Dr. Edward H. Kraus, dean of the University of Michigan College of Pharmacy; Dr. Rufus A. Lyman, dean of the University of Nebraska College of Pharmacy, and Dr. H. C. Biddle, dean of the University of California College of Pharmacy.

A STUDY of 21 backward reclamation projects, according to the *U. S. Daily*, was continued by a committee of economists and government reclamation officials at a conference at Chicago on November 13. The committee, named to correlate reports from various reclamation projects and to draft recommendations for the enactment of legislation to aid these backward projects, met recently at Washington and the conference was continued at Chicago. The government was represented by the commissioner of the Reclamation Bureau, Dr. Elwood H. Mead; the director of reclamation economics, George C. Kreutzer, and the assistant director and secretary of the committee, Dr. Hugh A. Brown. Other members of the committee are Professor Frank Adams, University of California; Dean Anson Marston, University of Iowa; Dr. Charles A. Lowry, President, Colorado Agricultural College; Dr. Alvin Johnson, of New York, A. C. Cooley, office of demonstrations on reclamation projects, Department of Agriculture, and J. W. Haw, director of agriculture, Northern Pacific Railroad. Following the conference a report will be submitted to the Secretary of the Interior.

THE second series of public scientific lectures at the Carnegie Institute of Technology was given on No-

vember 20 and 21, by Dr. Clinton J. Davisson, research physicist of the Bell Telephone Laboratories, whose subject was "The Wave Properties of Electrons."

AN address was made on October 21 before the Yorkville, New York, Medical Society by Professor Elmer V. McCollum, of the Johns Hopkins University School of Hygiene and Public Health, on "Where We Stand Now in Our Knowledge of Nutrition." Those who discussed the paper were Dr. Alfred F. Hess, Dr. Henry C. Sherman, Dr. Carl Sherwin and Dr. Walter H. Eddy.

PROFESSOR HARLOW SHAPLEY, director of the Harvard College Observatory, is delivering a series of five lectures at the College of the City of New York on successive Wednesdays. The dates and titles of the lectures are: November 20—"On the Kinds of Things"; November 27—"The Microcosmos"; December 4—"Concerning Planets"; December 11—"To the Bounds of the Galaxy and Beyond"; December 18—"The Cosmoplasma."

THE first Herzstein lectures sponsored by the medical schools of the University of California and Stanford University were given on October 7, 8 and 9, by L. A. Orbelli, professor of physiology, Medical Institute of Leningrad, Russia, on "Recently Acquired Knowledge about the Autonomic Nervous System." These lectures were endowed by the late Dr. Morris Herzstein, of San Francisco.

APPLICATIONS for physical chemist, associate chemist and assistant chemist must be on file with the Civil Service Commission at Washington, D. C., not later than December 31. The examinations are to fill vacancies in the federal classified civil service, for duty in Washington, D. C., or in the field. The entrance salaries range from $3,800 to $4,400 a year for physical chemist, $3,200 to $3,700 a year for associate chemist, and $2,600 to $3,100 a year for assistant chemist. Higher-salaried positions are filled through promotion. The optional subjects for associate and assistant chemist are advanced inorganic chemistry, analytical chemistry, organic chemistry and physical chemistry. Competitors will not be required to report for examination at any place, but will be rated on their education, training and experience, and on a publication or thesis.

THE Société Géologique de France was founded March 17, 1830, and is planning to celebrate its centenary by a general assembly of geologists in Paris on June 30, 1930, to which delegates will be invited from all parts of the world. Among its long list of distinguished presidents the society numbers Cordier, Alexandre Brongniart, Constant Prévost, Dufrénoy, Elie de Beaumont, Alcide d'Orbigny, Daubrée, Albert Gaudry, Hébert, De Lapparent, Mallard, Marcel Bertrand, Michel-Lévy, Munier-Chalmas, Emile Haug. The society is now under the presidency of Dr. Pierre Termier, a member of the ancient Academy of Sciences in Paris. Meanwhile a jubilee volume is being prepared to which contributions have been invited of geologists and paleontologists representative of various geological societies and academies. As senior geologist of the U. S. Geological Survey and Gaudry medallist of the society Dr. Henry F. Osborn is contributing to the volume a memoir entitled "Ancient Vertebrate Life of Central Asia. Discoveries of the Central Asiatic Expeditions of the American Museum of Natural History in the Years 1921–1929."

AN annual prize of $5,000 for distinguished service to agriculture in the United States is to be made available by Senator Arthur Capper, of Kansas. The prize is to be awarded first in 1930. The person to receive the prize is to be selected by a committee of seven which will formulate and announce the conditions to be met. The only requirement made by the donor is that the award be made for distinguished service to agriculture in the United States. The following are the members of the committee of award: John H. Finley, editor of the New York *Times;* Frank O. Lowden, ex-governor of Illinois and owner of Mississippi Farms; Carl R. Gray, president of the Union Pacific System; Walter T. Swingle, plant physiologist and agricultural explorer, U. S. Department of Agriculture; H. A. Morgan, president, University of Tennessee; James T. Jardine, director, Oregon Agricultural Experiment Station, and F. D. Farrell, president, Kansas State Agricultural College. Inquiries regarding the award should be addressed to the secretary of the committee, Mr. Floyd B. Nichols, Topeka, Kansas.

THE Turin Academy of Medicine has opened the contest for the fifteenth Riberi prize of about $1,000. Scientific works on any subject pertaining to medical disciplines, provided they constitute real progress in the field with which they deal, may be entered. Printed or typewritten works (two copies being required) composed in Italian, Latin, French, English or German are acceptable. Printed works must have been published since 1927. In order to be given consideration, books to be entered in the contest must be received by December 31, 1934.

SOME years ago, according to the *Experiment Station Record,* a gift of 25,000 rupees by the late Sir Ganga Ram, of Lahore, was made to the Punjab government for the endowment of a prize to be awarded for the discovery or invention of a practical method

which would tend to increase the profitable agricultural production of the Punjab. This prize, valued at 3,000 rupees and known as the Maynard Ganga Ram Prize, may be awarded every three years if proposals of sufficient merit are received. A world-wide competition is provided, and the date for the current competition has been extended to December 31, 1929.

PRESIDENT W. W. CAMPBELL, of the University of California, has received word that the University Dental College has been awarded the gold medal of the Third Latin American Odontological Congress, held in Rio de Janeiro, Brazil, for the excellence of an educational exhibit of dental work arranged by Dean Guy S. Millberry.

AN antelope sanctuary, said to be the only antelope range in the United States, which is being established by the National Association of Audubon Societies in the Last Chance district of Nevada, is to be presented to the nation for a federal preserve, according to plans outlined in the annual report of Dr. T. Gilbert Pearson, president, at the association's twenty-fifth annual meeting in the Museum of Natural History. It is hoped to acquire 1,000 acres of land, now controlled under an option, for $20,000. Half the purchase price has been pledged by friends of the association. 30,000 acres of land surrounding the association's holdings have been withdrawn from public entry.

UNIVERSITY AND EDUCATIONAL NOTES

MEMBERS of the board of trustees of the University of Pennsylvania have contributed a sum amounting to $1,750,000 to the university. Of this amount $1,000,000 was given without restriction, and the money has been used to cover deficits of $800,000, leaving $100,000 to be used for repairs and $100,000 for current purposes. The remaining sum of $750,000 will be used for the endowment of professorships.

WITH an anonymous gift of $130,000 the University of Cincinnati College of Medicine is constructing a laboratory of applied physiology on the campus at Eden and Bethesda avenues, directly behind the anatomy department. A new field of research, according to the *Journal* of the American Medical Association, will be carried on here dealing with problems that concern the application of physiologic laws to industry, including the protection of workers in dangerous chemical and metal industries, food contamination and ventilation. An annual gift of $30,000, also anonymous, provides for the maintenance of the laboratory.

MRS. AGNES H. ANDERSON, who in 1924 erected Anderson Hall on the campus of the University of Washington in memory of her husband, the late Alfred H. Anderson, has given $50,000 to the university. The income from this gift, which is known as the Agnes Healy Anderson Trust Fund, is to be used chiefly for graduate research fellowships in forestry.

AT Columbia University appointments have been made as follows: William Robert Torgerson, associate professor of tropical medicine; Hans Smetana, assistant professor of pathology; Kenneth S. Cole, assistant professor of physiology; James L. Joughin, assistant clinical professor of neurology; Josephine B. Neal, clinical professor of neurology; Claus W. Jungeblut, associate professor of bacteriology, and Philip B. Buchy, assistant professor of mining.

DR. FREDERICK H. KRECKER, professor of zoology in Ohio State University and assistant director of the Franz Theodore Stone Lake Laboratory, has been appointed head of the department of biology in the college of liberal arts of Ohio University at Athens.

D. S. VILLARS has resigned his position as associate in chemistry at the University of Illinois to accept an assistant professorship in physical chemistry at the University of Minnesota.

DR. CALVIN N. WARFIELD, formerly of the University of Richmond, is taking up his work as the head of the physics department of the North Carolina College for Women at Greensboro.

PROFESSOR J. W. GREGORY has retired from the chair of geology at the University of Glasgow after a service of twenty-five years. *Nature* says that during the period the membership of his classes has risen from 15 to 400, and in his last session he lectured to the largest geological class in the British Isles, if not in the world.

DISCUSSION

PHARMACOLOGICAL INJECTIONS AND PHYSIOLOGICAL INFERENCES

IN a recent article in SCIENCE,[1] Cori remarks that for twenty-seven years 0.2 mg of adrenin per kilo or larger amounts have been used in hundreds of animal experiments by many investigators and that if Cannon's judgment that such doses are "huge" and "far beyond physiological limits" is well founded it would be of far-reaching importance. That many investigators have commonly used such doses of adrenin does not prove them physiological. Unfortunately the lit-

[1] C. F. Cori, SCIENCE, 70: 355, 1929.

erature of endocrinology is replete with reports of the effects of adrenin and other similar preparations used as drugs and with inferences drawn therefrom as to their physiological action. Gley has stressed the dangers of that mode of thinking.[2] It is because such reasoning may lead to error that I called attention to Cori's use of it in a recent article in *Physiological Reviews*.[3]

Cori declares that in his experiments the absorption of adrenin from subcutaneous tissue "must proceed at a rate less than 0.001 mg per k per min." He marks that Cannon regards that rate as within the physiological range of adrenin secretion. There is evidence that it is within the physiological range, but only during and immediately after a short stimulation of the adrenal glands. There is no evidence that it continues at that rate. Recent work in the Harvard Physiological Laboratory by Colwell[4] has shown that continuous intravenous injection of adrenin into the cat at the rate of 0.001 mg per k per min. produces profound pathological effects on carbohydrate metabolism. Recently in the same laboratory Dworkin has demonstrated that when the sympathico-adrenal system liberates sugar physiologically, the hyperglycemia long outlasts the discharge of adrenin. The adrenin promptly disappears from the blood and leaves sugar utilization undisturbed. The continuous prolonged absorption of adrenin studied by Cori does not represent, therefore, a physiological process, and consequently the results obtained by means of it can not be regarded as normal.

Cannon pointed out that Cori's injection in rats would be the equivalent of 14 mg of adrenin in a man of 70 k. Cori objects to this reference to man. Let us consider rabbits. Trendelenburg[5] has shown that in rabbits a continuous intravenous injection of between 0.0001 and 0.0003 mg of adrenin per k per min. produces hyperglycemia and glycosuria. If the dose given by Cori—0.2 mg per k—were absorbed at the rate which, according to Trendelenburg, is capable of producing hyperglycemia and glycosuria, from eleven to thirty-three hours would be required for the absorption. Cori reports that in his experiments "hyperglycemia and glycosuria were present after one hour and persisted for four hours after the injection." He cites his recent tests which show that 35 per cent. of the adrenin he injects disappears during the first hour and 13 per cent. during the second hour. How these results are to be reconciled with his belief that there was in his experiments "a rather constant rate of absorption" is not clear. Neither he nor anybody else knows exactly how fast the adrenin enters the blood stream. On the basis of his own figures, however, the average rate of absorption during the first hour would be not less than 0.001 mg per k per min., as he has claimed, but more than that—*i.e.*, more than ten times the amount which Trendelenburg found was adequate for producing hyperglycemia and glycosuria and actually more than the amount which in Colwell's studies caused a striking pathological disturbance.

My sole interest in calling attention to the use of what can reasonably be regarded as huge doses of powerful endocrine products in experiments is to prevent physiological literature from being encumbered with misleading inferences. The giving of doses many times the minimal effective dose, the use of such doses subcutaneously with the idea that the rate of their absorption can be accurately known and the employment of a potent agency to act continuously for a long period whereas under normal conditions it does not so act, will, no doubt, yield data. Until such data, however, have been confirmed by experiments performed under more natural conditions, they should be interpreted cautiously in physiological terms.

W. B. CANNON

DEPARTMENT OF PHYSIOLOGY,
HARVARD MEDICAL SCHOOL

[2] E. Gley, "Les Sécrétions Internes," Paris, 1920, 93.
[3] W. B. Cannon, *Physiol. Rev.*, 9: 399, 1929.
[4] A. R. Colwell. Papers to appear soon in the *Amer. Journ. Physiol.*
[5] P. Trendelenburg, *Pflüger's Arch.*, 201: 39, 1923.

A PECULIAR LIGHTNING PHENOMENON

ON Monday afternoon, August 28, my brother and I were in the vicinity of Peoria, Illinois. The afternoon had been rainy, with two thunder-storms. The second storm was still raging with sharp lightning and the rain was falling in torrents but there was no wind. Just as we were ascending a gentle slope a very brilliant lightning flash occurred; the thunder was so violent that we both felt the mechanical shock as if the car had been shaken and each felt the electrical shock especially in the shoulders.

The flash appeared to be just on our right in an open pasture crossed by what was once an osage hedge, but now only a few small trees of the hedge remained at intervals of twenty to thirty feet. About six feet from the trunk of one of these hedge trees we observed a ball of smoke about two feet above the ground. The ball appeared to be about eighteen inches in diameter and perfectly spherical. The color of this smoke, if it was smoke, was a yellowish brown quite similar to the smoke given off by burning straw. The ball began immediately to diffuse into the surrounding air just as the smoke from an exploding shell.

The storm being so forbidding, we did not care to investigate the spot at the time but we returned three days afterwards and searched very carefully and minutely for some evidence that the lightning had

struck in the vicinity of the ball of smoke. Not the slightest trace of any disturbance could be found. We could not find even a withered twig or leaf. It was first thought that the smoke might have been produced by the lightning having burned some of the limbs or weeds. If any crack or disturbance of a small character had been formed in the bare ground it would have been obliterated by the heavy rain. Evidently the ball could not have been composed of dust, for it had been raining for about two hours. We measured the distance from our car to the place where the ball had appeared and found it to be about one hundred feet. We raised the question of whether or not this "ball of smoke" would have been a "ball of fire" if the phenomenon had taken place after dark.

GEORGE WINCHESTER
RUTGERS UNIVERSITY

THE PUBLIC FUNDS

I READ in the newspaper of the enormous sums of money which can be saved to the United States, as well as to other countries, if President Hoover's policies can be adopted. In the interests of peace and prosperity, he should surely receive our support; but I believe the issue would be clarified and vivified if we could feel assured that the saved resources, or some reasonable part of them, would be devoted to the support of specific undertakings of a useful character. Thus, from my particular angle, I think how small a fraction of the funds referred to would be entirely adequate to provide for the compilation, editing and publication of a North American Fauna. How little it would require, comparatively speaking, to enable entomologists to explore the world for scale insects and mealy-bugs and their natural enemies, and describe the results, to the great advantage of agriculture and horticulture. What small sums, in proportion to the proposed savings, would suffice to provide popular books on natural history for all sections of the country, cheap and well illustrated, contributing everywhere to the culture of the people. Could the president appoint a committee, sufficiently varied in its character, to receive and report on desirable projects, for the purpose of causing people to sense the possibilities before them? Many would be proposed, but enough might be adopted to keep us hopeful and interested, and alive to the value of our resources.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO

THE PUBLICATION OF PAPERS FROM RESEARCH INSTITUTIONS

IN the introduction to Volume II of the Abridged Scientific Publications from the research laboratory of the Eastman Kodak Company, which was written in May, 1917, the following passage occurs:

> In our opinion, it is undesirable for a research laboratory to confine its publications to a privately issued bulletin, and it is better for scientific papers to be published in the usual scientific and technical journals, where they are accessible to all those interested in the branch of science concerned.

This was a protest against the publication by research institutions of their own journals, in which the papers produced by the laboratory appear. Unfortunately, the views expressed in that note have not been shared by the directors of other research laboratories, and the number of special journals continues to increase, these journals being filled with papers from many branches of science, so that they place a severe burden upon the abstractor and bibliographer.

Recently, an even more serious difficulty has appeared, since the editors of these journals, in their anxiety to obtain material which shall make it necessary for libraries to take their journals, have begun to insist on the right of prior or simultaneous publication. The result of this is that papers read before meetings of some scientific societies are actually unavailable for the journals of these societies, since they reprint papers which have already been published, and the journals of the laboratories insist on prior publication of the papers.

The society journals can, of course, retaliate and demand prior publication, but in view of the commercial interests involved this would mean that a large number of scientific papers would be unavailable at society meetings.

It appears to me that it is desirable that laboratories which have already established journals should allow papers read at society meetings to be published first by the society in question and, secondly, that new research laboratories which have not already published their own journals should refrain from doing so and support the existing scientific journals with their material, and, if possible, with some of the funds which the publication of their own journal would have involved.

In order to make available all the material from the same institution in a collected form, since they will naturally have some common interest, the papers can be reprinted annually in a volume—either in whole or in the form of abridgments—a practice which has been followed with success by our laboratory for the last fifteen years.

C. E. KENNETH MEES,
Director, Research Laboratory
EASTMAN KODAK COMPANY

SCIENTIFIC BOOKS

A Handbook of the Dragon-flies of North America. By JAMES G. NEEDHAM and HORTENSE B. HEYWOOD. 378 pages, with about 650 figures. Published by C. C. Thomas, Springfield, Ill., 1929. Price $7.00.

THE long-looked-for volume by James G. Needham and students on North American dragon-flies has finally appeared and will undoubtedly stimulate interest in this fascinating group of insects. It is almost a prophetic voice crying in the wilderness, as work on the Odonata has ebbed in recent years and few young students have taken up work on the order. The older workers are gradually becoming less productive as their time becomes absorbed by increased duties of other kinds. New students are not being developed, as the study of dragon-flies has been crowded to the wall by the ever-insistent call for men trained in applied entomology. C. Francis Byers, B. Elwood Montgomery, Theresa M. Seemann and Elsie Broughton comprise the whole of the younger generation working on this group. The main difficulty for beginners has been the matter of literature. The beginners who have been able to work had access to the library of some one of the older workers. Without a good library work on North American Odonata has been impossible. Muttkowski cited the literature up to the year 1910 in his "Catalogue of North American Odonata." The present handbook of Needham and Heywood lists the literature down to date. It gives a new impulse and a new starting-point for students.

As early as the year 1900 Professor Needham announced to the systematists interested in Odonata that he was working on a volume on North American dragon-flies. The specialists shrugged their shoulders. It appeared to lesser minds to be a colossal task. However, Dr. Needham's usual sound judgment came to his rescue as he sensed the great amount of preliminary work involved, and the book was deferred from year to year until twenty-nine years later it has appeared in creditable form. Odonatists shudder when they think what the volume might have been if published before the great amount of revisional work of the present century had been completed.

The "Dragon-flies of Indiana" by E. B. Williamson appeared in 1900, the year of Dr. Needham's announcement. Between 1901 and 1908 appeared Calvert's volume on Central American and Mexican dragon-flies in the Biologia Centrali-Americana which represented ten years of unremitting toil. This cleared up the genus Argia and blocked out the species of the southwestern United States. Next appeared Muttkowski's "Catalogue of the Odonata of North America,"[1] which was accomplished by the loan of E. B. Williamson's nearly complete private library and a wide correspondence with specialists as to the exact status of doubtful species. This catalogue is still cited by writers and students as a model in entomological work and was the first painstaking sorting of the material for monographic work on North American Odonata. It has been the bible of all American workers. In the years 1909 to 1913 appeared Dr. F. Ris's monumental work in 1,278 quarto pages, "Die Libellulinen,"[2] which monographed the libelluline dragon-flies of the world and which straightened out the American genera Sympetrum, Libellula, etc. This is the largest and one of the most perfectly done pieces of work ever published on Odonata. Later appeared E. M. Walker's two monographs, "The North American Dragon-flies of the Genus Aeshna" and "The North American Dragonfiies of the Genus Somatochlora."[3] This work covered a period of over fifteen years in which practically all American material was examined and numerous collecting trips were made in eastern and western Canada. These are monographs that are as nearly perfect as such can be made and which straightened out two large genera that were unbelievably scrambled. Besides these Walker published "The Odonata of the Prairie Provinces of Canada"[4] and "The Odonata of the Canadian Cordillera,"[5] with numerous shorter papers. During this period appeared Howe's "Manual of the Odonata of New England,"[6] which compiled all distributional data of New England dragon-flies, while during the same time appeared various papers by the present writer on the Odonata of the Pacific states. Such is the mass of preliminary and critical work that was necessary before a sound monographic work on North American Odonata could be undertaken. As work stands now there remains only one large genus that needs critical revision, this is the genus Gomphus with its seventy-five species. Plans are now on foot to get this cleared up in the next few years. With this done the pioneer work on North American Odonata will have been practically completed. This outlines the problem that Professor Needham faced in 1900 when he first announced his decision to write a book on North American dragon-flies. It was a daring project, a magnificent vision and has finally been accomplished.

The volume is a beautiful example of the printer's art and is illustrated with six hundred and fifty line drawings, mostly of genitalia, which have the safest characters for species determination.

It is arranged in two parts. Part I—General—pages 3 to 46, is written by the senior author and

[1] Bull. I, Public Mus. Milwaukee, 1910.

[2] Coll. Zoo. de Selys.

[3] Univ. of Toronto Studies, 1912 and 1925.

[4] *Can. Ent.*, 1912.

[5] Brit. Col. Special Publ., 1927.

[6] Mem. Thoreau Mus., 1917–23.

covers the general biology of dragon-flies in a broad and delightfully written manner. The subheads are "Life of a Dragon-fly," "The Adult Dragon-fly," "Immature Stages," "The Eggs" and "Dragon-flies and Fish Culture." Naturally each is very briefly sketched. It is interesting that the one part of the structure of dragon-flies that is now making Odonata specialists lie awake nights and defer publishing until it has been settled, namely, the correct terms for the veins of the wings, is referred to in a short foot-note only. This is Tillyard's criticism of the present Needham system of terms for the veins of the wings. The situation of vein terminology is similar to the recent situation in physics concerning corpuscles and ether waves. Each side has what appears to be good evidence. While a discussion of terms for wing veins would have satisfied a great yearning among specialists, Dr. Needham undoubtedly used good taste in omitting such controversial subjects.

Part II—Systematic—covers pages 51 to 357 and is the body of the book, Part I being introductory to it. It contains short descriptions with brief keys, tables of characters of the known nymphs and illustrations of male and female genitalia. Each description is preceded by one or more selected references and a statement of distribution by states, and is frequently followed by a quotation on the habits of the species. As stated in the preface the systematic work is the combined product of Professor Needham and a group of graduate students. Except C. Francis Byers, the student authors appear to have had little experience to guide them past the pitfalls of taxonomic writing and no comprehension of the vast amount of toil involved in finished work of this type. In the rush of work before Dr. Needham left for his year in China, Mr. Byers bore the brunt of the effort to get the volume finished. His treatment of the genus Enallagma is the only comprehensive work we have on this group. Because of the difficulty of figuring Argia appendages in simple line drawings his treatment of this genus is not as satisfactory. With its thirty-six United States species it is the most difficult genus included in the handbook.

The reviewer can locate no statement of the area covered by the systematic treatment. Apparently it is North America north of Mexico and the West Indies. When the distribution of a species extends south of this area the fact is se'dom stated. A tropical species with a United States distribution in Arizona would have its distribution indicated as "Ariz." The new student would be interested in knowing when he picked up such tropical or Mexican forms so far north.

The treatment of distribution could have been much more thoroughly done. It is merely a matter of hard work and lots of it. Apparently the recent literature was very casually covered for the more recent records. Professor E. M. Walker complains:

> The weakest portion of the work is that dealing with the distribution of the various species, although to judge by the introduction, it is supposed to be one of the prominent features of the volume. From the standpoint of our Canadian species the records are woefully inadequate and it would appear as if our Canadian literature of the past fifteen or twenty years dealing with the Odonata had been almost intentionally neglected. One of the most flagrant examples is found in the genus Ophiogomphus where only a single Canadian species is recorded, *viz.*, *O. occidentis* Hagen from British Columbia: at least seven species of this genus have been reported as occurring in the dominion.[7]

The reviewer has checked but a few species for distribution and has immediately run into equal omissions. *Argia emma* Kennedy is recorded in the handbook as from Washington only. The present writer has published (1917) eleven records of this species for Nevada and California where it is found as far south as Fresno. Walker has published (1927) two records of it for British Columbia. It is probably an exceptional case. However *Macromia magnifica* McL. is recorded from "Calif. and Ariz." Nine lines below Needham quotes the present writer's description of its habits as observed on Satus Creek, which is in the Yakima Valley, Washington, but which Needham in his reference places on the "Umatilla flats, Oregon." The record of *Macromio pacifica* Hagen for California is still included though no authentic specimen of this species has ever been taken west of Kansas or Waco, Texas. The original type is in the Museum of Comparative Zoology and bears the label, "Pacific Railroad Survey, lat. 38°." Apparently the specific name referred only to the Pacific Railroad Survey which started in Kansas and had no biological connection with California. This record was questioned by the writer in his paper "The Dragon-flies of Kansas" in 1917. These are samples that bear out Professor Walker's impression of the insufficiency of the distributional feature of the book, which is one phase of the work that a painstaking stenographer could have done. All these recent papers are listed in the bibliography at the back of the book and so were available to the authors.

Why *Brachymesia furcata* Hagen should be placed in the genus Sympetrum puzzles the reviewer, if for nothing more than that the illustration of the male genitalia (p. 235), because of their conspicuous differences from those of the parallel species of Sympetrum, spoil the regularity of the illustration. However, the writer did the same thing by mistake once and nearly described *furcata* as a new and very distinct species of Sympetrum from Phoenix, Arizona. The mistake

[7] *Can. Ent.*, May, 1929.

was caught just before mailing the description to the *Canadian Entomologist*. It was very disconcerting because *furcata* does not look like a Sympetrum. Neither does the writer understand Needham's treatment of the three species, *Ophiogomphus phaleratus* Needham, *O. occidentis* Hagen and *O. severus* Hagen. The description states that the superior appendage of the male *occidentis* is less pointed than that in *severus*, but the illustration shows the reverse. Also to which of three species do the female genitalia in the figures on pages 74 and 76 belong, presumably to the top and bottom species.

Walker has already pointed out[8] that the illustrations for *Gomphus furcifer* Hagen and *G. villosipes* Selys are interchanged as are those of *Somatochlora whitehousei* Walker and *S. septentrionalis* Hagen. To these can be added the transposition of the figures of *Lestes vidua* Hagen and *L. forcipatus* Rambur. A half dozen critical mistakes have already been discovered in the keys in spite of the fact that catching such errors is the real work of taxonomic writing. Dr. Needham has been frank about these errors and has already circulated a mimeograph sheet to specialists for the listing of such mistakes. These will be published as an extra folder to go with each volume sold. After we have written these corrections into the beautifully printed volume and forever marred its craftsmanship one rather wishes that the authors would give a slight rebate on the price to offset this injury to a seven dollar book.

The handbook will be useful in that it will stir up interest in the Odonata, but before publishing the student will still have to review and check up the literature that has appeared since Muttkowski's catalogue came out in 1910. This can be done by the use of the bibliography at the end of the book which lists the literature since 1910 and appears to be well done. Thus, as stated in the preface, "The Handbook of the Dragon-flies of North America" is "a book for collectors," but it is a book of doubtful value to specialists.

CLARENCE HAMILTON KENNEDY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD OF RECORDING MAXIMUM AND MINIMUM TEMPERATURES OF FOREST SOILS

INVESTIGATORS who have had occasion to use maximum and minimum soil temperatures have found that present methods are cumbersome even if technically adequate. Bates and Zon[1] state that "the use of registering maximum and minimum thermometers in soil temperature work is not very satisfactory." To secure accurate readings it is essential that the bulb of the thermometer be in direct contact with the soil. Furthermore, the instrument should receive a minimum of exposure to the atmosphere while the readings are being taken. Because of the differences in diathermic properties of air and soil, thermometers placed in wells are subject to considerable error, while the sudden temperature changes necessary to reset the instruments produce strains which may affect the accuracy of such instruments.

Various means have been suggested for the elimination of the difficulties mentioned above. Bates and Zon[1] proposed a bent tube minimum thermometer and a superrefined maximum thermometer with a constriction fine enough to prevent absolutely the return of mercury to the bulb even when in an upright position. Toumey and Stickel[2] used a system whereby the thermometers are placed in a small hole in the side of a pit and at a distance of several feet from the pit.

Thermographs are suitable for accurately recording soil temperatures but necessitate great care in the installation of the instruments, besides requiring frequent checking by standard thermometers. The price of thermographs also tends to make general use of them prohibitive.

In seeking to develop an improved technique for soil measurements, the writer found that there is on the market[3] a modified Six's maximum and minimum thermometer well adapted to recording soil temperatures in the forest.

The instrument, originally designed for incubator use, consists of the usual maximum and minimum features of the Six system, incased in a glass tube. The upper portion of the tube contains the scale, while the lower end is constricted and elongated to hold the bulb, which is some seven inches below the recording scale. The greater diameter of the casing is .7 inches and the smaller .3 inches; the entire thermometer is fifteen inches long. The scale reads from minus 20° to plus 50° C. The Six type of thermometer is generally considered somewhat less precise than standard recording thermometers, but apparently the instrument here described is constructed with sufficient accuracy to warrant its use in forest investigations. Table I shows the differences in reading between such an instrument and a standard soil thermometer read each day at 8:00 A. M. from January to June, 1929, at the one-foot soil depth.

[8] *Can. Ent.*, May, 1929.

[1] C. G. Bates and Raphael Zon, "Research Methods in the Study of Forest Environment," U. S. D. A. Bul. No. 1059, May, 1922.

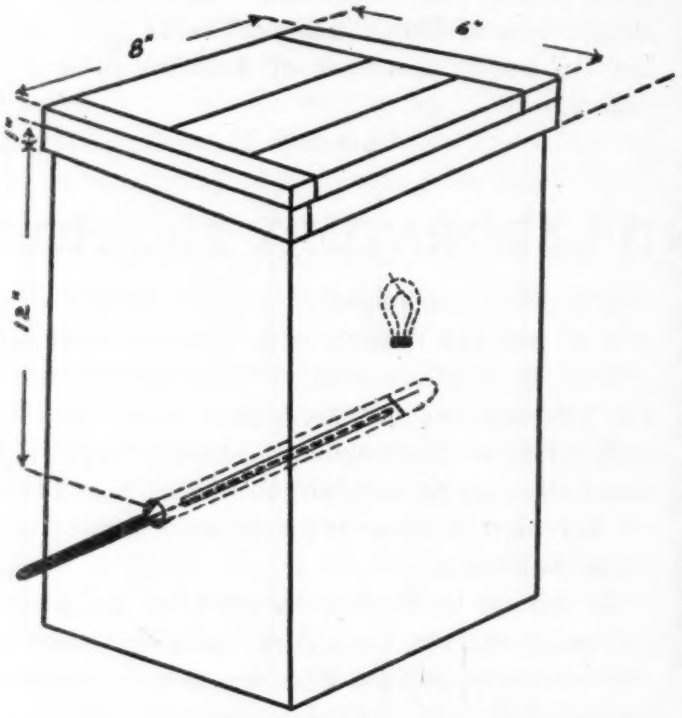
[2] J. W. Toumey and P. W. Stickel, "A New Device for Taking Maximum and Minimum Soil Temperatures in Forest Investigations," *Ecology*, vol. vi, No. 171, 1925.

[3] Arthur H. Thomas Co., distributor, Philadelphia, Pa.

TABLE I

	Mean (Degrees Fahr.)	Standard deviation (Degrees Fahr.)
Standard thermometer	67.77 ± .57	11.00 ± .40
Six's thermometer	67.27 ± .56	10.90 ± .40
(D) Difference	.50	.13
(PED) Probable error of difference	.79	.56
D/PED	.6+	.2+

In use this thermometer is placed horizontally in a boxed pit so that the bulb extends into the soil six inches from the side of the pit. The two ends of the scale rest on the sides of the box within the pit (Fig. 1). When readings are made the cover of the pit is



BOX PIT WITH SIX'S THERMOMETER IN POSITION

removed, the temperatures recorded, the indices drawn back to the mercury by means of a magnet and the pit is again covered. In application the thermometer can be placed at any desired distance from the surface of the ground, within the reach of the observer. Its most practical uses are at six-inch and one-foot depths. Greater depths will require a flashlight for reading and a considerable enlargement of the pit to facilitate resetting.

The principal advantage of the Six's maximum and minimum thermometer in obtaining soil temperatures are: (1) The bulb remains at all times in contact with the soil. (2) Readings can be taken with the least possible exposure of the instrument to the atmosphere. (3) The instrument is relatively inexpensive, costing no more than a single standard instrument. (4) The instrument can be used with satisfactory results under forest conditions even in heavy brush where it is often difficult to reset standard maximum thermometers.

E. W. GEMMER, JR.
SOUTHERN FOREST EXPERIMENT STATION

A QUANTITATIVE CLOSING NET FOR CATCHING PLANKTON ORGANISMS

FOR many years investigators of quantitative distribution of plankton, both of marine and fresh-water types, have recognized the need for a device capable of capturing the organisms in a certain quantity of water. For most of the fresh-water plankton, and for particular kinds of marine plankton, closing bottles have been found to give satisfactory results. But none of these bottles are large enough for many of the important forms of marine zooplankton.

It seems to be generally understood that a net of cylindrical shape is most likely to be practicable for accurate operation in taking a sample of designated size, but it has been found difficult to plan construction which would result in an instrument which could be operated easily and rapidly. After several years of more or less frequent consideration of the problem I have finally developed a design which is simple, fairly easy to operate, and which can be manufactured at moderate cost. Inasmuch as the Scripps Institution is not doing quantitative work with zooplankton at present it may be a considerable time before a model is constructed and I offer this brief note so that others can make use of the idea if they have need for such equipment.

In outer view when closed the net is a cylinder with metal ends connected by side walls of cloth (*e.g.*, No. 12 silk or No. 000 linen). A median sectional view in approximately half-open position is roughly indicated in Fig. 1. The sliding wheel (S) to which the lower edge of the cloth is attached has been raised from the bottom plate (B) to which it was tightly fastened when closed. The cloth (F) is thrown into folds between the margins of S and the top plate (A). The central support and guide rod (C) is left exposed to view by lifting of the fabric.

The bottom plate (B) is offset upward in the center to form a dome into which the central rod (C) can be fixed, and through the open sides of which water can drain from the plate into the detachable cup (R) indicated by the dotted line beneath. Plate B must be heavy and rigid to prevent distortion and consequent ill fit when the wheel (S) joins it to close the net and prevent escape of enclosed organisms. Its margin must be recessed or otherwise provided

with accurate means for holding the hook or pin fasteners on the sliding wheel (S) at closing.

The central supporting rod (C) should be square or otherwise shaped to prevent twisting of the net in opening and closing.

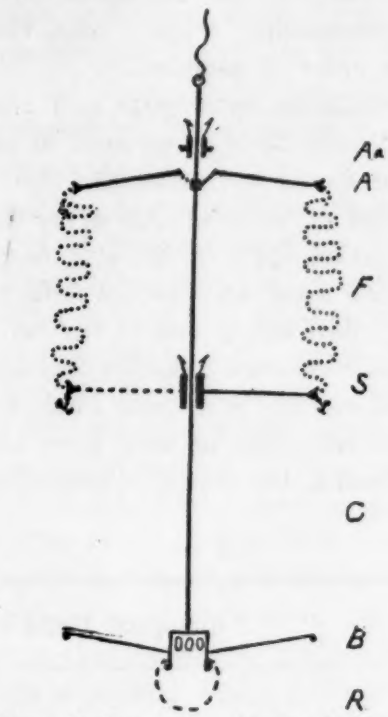


FIG. 1. Allen closing net. About half open to show main features of design. For explanation see text.

The sliding wheel (S) must be heavy and rigid to insure rapid and accurate closing after release by messenger at the desired depth. Its rim must be flanged in order to hold securely the lower end of the hollow cylinder of filtration cloth (F) which can be tied to it. The flanged rim should be connected to the central hub by enough spokes to prevent warping of the wheel. The hub must have enough length to avoid binding and it must fit the rod (C) loosely enough to allow free sliding. On the upper end of the hub must be set catches to hold the wheel near the top plate (A) until released by messenger.

The filtration walls (F) should be made of cloth appropriate in size of mesh to the organisms to be caught. If made up as a hollow cylinder just large enough to slip over the end plates and sliding wheel one kind of cloth can be quickly detached and another kind tied in its place on the flanges of S and A.

The top plate (A) must be flanged at the margin for attachment of the filtration cloth as on the sliding wheel (S). In order to prevent too great accumulation of organisms on the folded cloth while descending to the desired level the plate must have an opening at its center. Therefore, it must be supported on arms (or braces) rigidly attached to the supporting rod (C).

The top plate valve (Aa) must have considerable weight because when released by the cable messenger it must in closing the top plate opening act in turn as a messenger to release the sliding wheel (S) to close the net. On its top it must have catches to hold it up until released by the cable messenger.

In operating (at least at sea with a rolling and pitching boat or ship) it will be necessary to attach a pendulum stabilizer, perhaps a window weight at the end of fifty feet of line. For suspension of this stabilizer it will probably be best to attach a stirrup to the bottom plate (B) astride the drain cup.

It seems fairly certain that this net (which is to be operated in the vertical position) can not avoid a slight error through entangling some organisms at higher levels while descending to a selected level. But, with the central opening in the top plate, this error should be negligible quantitatively.

It is obvious, also, that the weak point in the design is the possibility of leakage between the sliding wheel (S) and the bottom plate (B) when the net is closed around a catch. If the joint is tight enough to prevent passage of the organisms being sought leakage is not important, but its possibility must be considered at all times. Since most fabrics used for zooplankton will allow quick drainage through filtration orifices as the net leaves the surface of the water when being hauled in, it seems improbable that much pressure will be exerted against the joint. Therefore, if its faces are ground to fit loss should not occur even if no fasteners be used.

I have in mind a modification of this design whereby the net could be closed by upward instead of downward slide of the sliding wheel, but its structure and operation would be so unwieldy that it can hardly be as practicable as the basic design.

Judging from my three years of experience with fresh-water plankton of the San Joaquin River a closing net to handle one hundred liters of water would be satisfactory for fresh-water organisms. A cylinder 42 centimeters in diameter and 74 centimeters long would enclose 102.4 liters.

Experience and information available from many years of plankton work in the ocean waters of southern California indicate that a net filtering one hundred liters will also be satisfactory for much of the marine zooplankton. However, there is much work for which larger closing nets are desirable. A cylinder 60 centimeters in diameter and 90 centimeters long would enclose 254 liters, and 505 liters could be taken with one 76.2 centimeters in diameter and 110 centimeters long. It seems doubtful that the design would be practicable for a net of greater capacity than one half of a cubic meter.

WINFRED EMORY ALLEN

SCRIPPS INSTITUTION
OF OCEANOGRAPHY

SPECIAL ARTICLES

SOME PHYSICOCHEMICAL ASPECTS OF LIFE, MUTATION AND EVOLUTION[1]

THE conversion of non-living matter into living matter by growth and reproduction is generally considered one of the least comprehensible of natural phenomena. An attempt is made here to translate the mechanism of life into terms of better known and more readily grasped physicochemical concepts.

The chemist and physicist, starting with atoms and electrons, have been working upward into larger units, the molecules, and still larger units, the molecular groups, while biologists have been steadily working downward to smaller and still smaller hereditary units in the cell. These two groups of investigators have been approaching each other from opposite directions. It is no simple task to make a perfect joining of the two pathways.

The principal *physical* units or groupings recognized at present in dealing with phenomena are shown in the table. Opposite each unit or group, is set, for convenient comparison, the biological unit of approximately corresponding order of size, though perhaps of greater order of complexity.

With the geneticists, cytologists and other biologists here assembled, there is no need to review the nature of chromosomes and genes, and their behavior in the mechanism of mitosis. All agree that in the normal reproduction cycle of the cell, each chromosome doubles its mass and divides into two equal parts, and each part enters one of the two daughter cells. The genetic evidence indicates that the chromosomes, which themselves bulk quite small in a microscopic field, are composed of very large numbers of particulate subunits, the genes. Calculations of the

TABLE

Physical Units	Approximate Diameters	Biological Units
Electron { positive	2×10^{-8} Å	
Electron { negative	3.8×10^{-8} Å	
Atomic nucleus { H	2×10^{-8} Å	
Atomic nucleus { Au	4×10^{-7} Å	
Atoms	0.1–0.6 mμ	
Molecules	0.2–5 mμ	{ Moleculobiont (Hypothetical simplest life)
Molecular groups	0.5–10 mμ	
Primary colloidal particle	2–20 mμ	
Secondary colloidal particle	5–100 mμ	{ 20–70 mμ Gene (*D. melanogaster*)
		{ 50 ± mμ Bacteriophage
		{ 2 ± μ Coccus
Microscopically visible particle	over 100 mμ	{ 0.2–3.5 μ Chromosome (*D. melanogaster*)
		{ 5–15 μ Nucleus (*D. melanogaster*)
		{ 7–25 μ Cell (*D. melanogaster*)
Visible particle	over 50 μ	
Mass	over 1 mm	2.5 mm *Drosophila melanogaster*

		Equivalents	
Planet (Earth)	1.3×10^{4} km	1 Å	$= 1 \times 10^{-7}$ mm
Solar system	5×10^{9} km	1 mμ	$= 1 \times 10^{-6}$ mm
Star cluster	5×10^{3} lt. yr.	1 μ	$= 1 \times 10^{-3}$ mm
Galaxy	5×10^{4} lt. yr.	1 lt. yr.	$= 9.4627 \times 10^{12}$ km
Einsteinian universe	2×10^{9} lt. yr.		

Many of the difficulties arise from the fact that attention is not focused upon vital units sufficiently simple in their nature to be comprehended in both structure and behavior. Even the smallest cell or unicellular being is an exceedingly complicated structure. If we would form a precise mechanical picture of what occurs in life, we must dissect down through the layered structure of its matter, until we reach the simplest unit which can be regarded as living. The tiny ultimate vital units, from their ultramicroscopic domain, direct and dominate the material changes of life.

[1] Presented before the Genetics Sections of the American Society of Zoologists and the Botanical Society of America, at the meeting of the American Association for the Advancement of Science, December 28, 1928.

size of genes have shown that they must be of the order of very large organic molecules or of small organic molecular groups. Further, the evidence (especially from linkage and crossing-over) indicates that each of these chromosomal subunits actually reproduces itself *next* to itself. Genic reproduction is self-duplication *in situ*.

Since the addition, removal or modification of these subunits, the genes, produces marked and characteristic changes in the cell and in what develops from it, we are justified in regarding them as specific catalytic particles which direct chemical changes within their respective domains, and thus dominate developmental and life processes. It is the genes, within the gene-strings or chromosomes, which deter-

mine whether a certain cell will develop into a flea, an elephant or a man.

To epitomize the biological evidence, the genes are particles, of molecular order, which locally duplicate themselves from what is admittedly non-living matter, and which control and direct the material changes of development and life. Can we interpret such behavior in the light of our present chemical and physical knowledge? It seems to us that this can be done through the idea of catalytic synthesis.

Before considering the modern view of catalysis, let us first review some consequences of the structure of matter which make catalysis possible and specific. When electrons and protons combine to form atoms, when atoms combine to form molecules and when molecules combine to form larger groups, there are always left over some outwardly directed, unsatisfied fields of force. The residual forces of molecules exert powerful attractions or repulsions on particles which come within the range of attraction.

If we consider a single molecule, or a very small molecular group, *A*, it is obvious that the residual electrostatic or electromagnetic surface forces present to the milieu a mosaic which is highly specific in various directions. In Fig. 1 the specific nature of

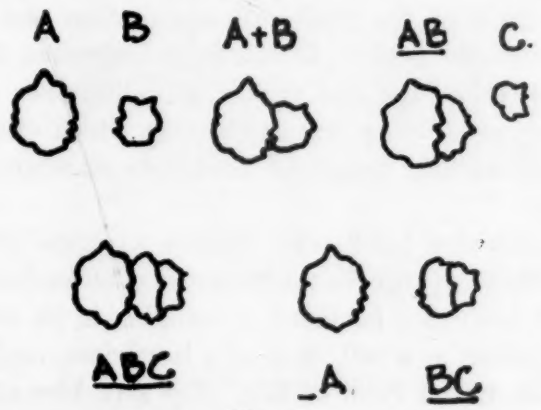


FIG. 1

the surface of *A* is shown very diagrammatically by the convention of specific jaggedness in the outline. In consequence of its mosaic pattern, a particle may exhibit several different kinds of specific actions separately or simultaneously, on different portions of its periphery.

Let us now imagine a simple molecule, *B*, approaching *A*, and the process of fixing itself at the surface. This will occur only if the surface charges presented by the approaching molecule bear a lock-and-key relation to those of the particle, and if the velocity of approach lies within critical limits.

As soon as the oppositely charged areas come within their critical distance, fixation occurs, as is diagramed $A+B$. Instantaneously thereafter occurs a mutual neutralization of forces and a complete reshuffling of all the internal and surface fields. The compound molecule, after the fixation, will present to the milieu a different configuration from what it presented before fixation. This is diagramed as *AB*. The former *B* portion might now be able to make other attachments previously not possible to it. The attachment of a second molecule, *C*, would once more cause a reshuffling of all the fields involved, as is diagramed *ABC*. Now, if the resulting bond between the two added molecules were stronger than the bond between the former *A* and *B* portions, then there might be released to the milieu a new type of duplex molecule, *BC*, while the fixation surface of *A* would be freed for renewed action.

Suppose now that we have a catalyst particle composed of several simple molecular subunits which we can diagram roughly as *A* in Fig. 2. Suppose that

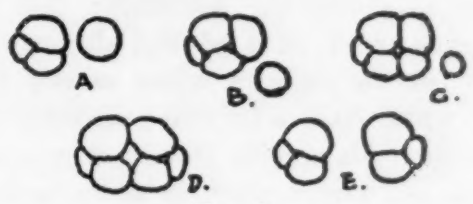


FIG. 2

at some one of its faces the catalyst fixes or adsorbs the several subunits of which it is composed; that, because of the order of their fixation or because of the reshuffling of electronic fields which follows each addition, these component subunits form a new group identical with the fixation or catalyst group, and suppose, lastly, that the duplicate particles now separate or are separated. Each would be an exact duplicate of the other in catalytic and in self-duplicating behavior. Our original particle could properly be called an *autocatalytic catalyst*.

As an example of a simple and well-known chemical process, analogous in a rudimentary way to the autocatalytic synthesis postulated above, one may mention the formation of crystals of the alums. If to pure cold water is added the salt potassium sulphate and the salt aluminium sulphate, a solution strongly supersaturated for the potential double salt, alum, may be obtained. But, in the absence of a fragment of a previously formed crystal of alum the supersaturated solution remains practically indefinitely without giving rise to alum crystals. However, if a tiny fragment of alum crystal is dropped in, or was present in the materials used, at its surface occurs an adsorption of the two separate salts together with a definite number of water units, the whole addition condensing into a very specific space lattice with repetitions of the unitary alum complex. Mechanical, or even thermal, agitation may break the bonds between the newly formed alum complexes and

the parental crystal, so that a host of descendants may grow and reproduce in the nutrient solution.

We do not contend that an alum crystal constitutes simple life, although there may be some who would do so. In vital units the building stones of the finer structure are not potassium, aluminium and sulphanion, but are carbon, nitrogen, phosphorus, etc., which are united in a unit complex which is far more voluminous and involved than alum is. Besides this difference in constituents, or more probably because of it, the units properly called vital are more flexible in their bonding and more diversified in the activities carried on at the catalytic surfaces.

The simplest living units of which we have indisputable evidence are the genes. The forces governing the reproduction of each gene are known to be *within* the individual gene. In evidence of this we need cite here only the well-known fact that in a heterozygote, each gene of the allelomorphic pair picks out of the common milieu exactly those constituents which lead to its own particular formation. Furthermore, this specific formation occurs nowhere else in the cell except precisely at the locus occupied by each particular allelomorph. All these properties conform to our postulated autocatalytic reproduction.

We would like to point out one more property of genes which has its analogue in a rudimentary way in the alum crystal. The growth rates of the genes of a given cell are remarkable in their uniformity. This holds true not only for a given temperature but throughout the great range of temperatures to which some organisms are adapted. If a particular gene did not keep step with the others it would either overreproduce or else fail to reproduce in time to be included in the daughter cells with the other genes.

Not simply this uniformity in temperature characteristics, but a considerable number of other properties, for example, the universal synthesis of the substance called chromatin, which envelops the genes or the string of genes, and the remarkable similarity in chemical constitution of nuclear materials as revealed by the exceedingly crude methods of chemical analysis now available, all point to one striking conclusion. This conclusion is that the genes may all be viewed as simple variants of one fundamental structure. We may suppose that their power of autocatalytic synthesis is the outcome of the possession of a common pattern of structure, and that the different allelomorphs, or indeed the different genes in a given cell or even the different genes in apparently very widely separated forms, are the same except for differences in the fringe of the gene, in its side chains and in localized additions or substitutions.

To return to our oversimplified analogy in the alum crystal: it is remarkable that alum crystals retain their specific structure through a host of substitutions of materials, or "mutations." Thus, rubidium, caesium and even ammonium can be substituted for the potassium; iron, manganese, etc., can be utilized instead of the aluminium; selanion (SeO_4), etc., instead of the sulphanion. The most essential characteristic of an alum crystal seems to be the particular strain set up in the local ether when alum crystals originated. It is the *structure,* the particular space-lattice present, that matters, and the points in that lattice can be taken by any materials whose outwardly directed fields of force are flexible enough to adapt themselves to the particular "set" that is in the local ether.

Although the gene is the simplest vital unit definitely known, it is possible that in some cases the gene is itself an aggregate of simpler autocatalytic units which have been called "gene elements," or "genels." The hypothetical lower limit of vital units is in the molecular order, for nothing simpler than a molecule, for example an atom, depends for its *increase* in numbers upon forces contained only within the unit itself.

The question arises: is there in nature any free-living unit of the grade of organization and properties of the gene? It has been suggested that in the bacteriophage and similar ultrafilterables we are dealing with living beings (bionts) which either are actually of this degree of simplicity or approach it closely.

Considering briefly the bearing of these ideas on the origin of life—a very speculative endeavor—it would seem that no biont as complex in its order of aggregation as a cell, or even a bacterium, could have been an initial form of life. The structure of a cell is a box-within-box series of units, of successively simpler orders of aggregation, and it seems reasonable to suppose that the simplest of these units was the first to appear in evolution. Life began, then, in the molecular order of complexity with an autocatalytic molecule of definite structure and less definite constituents. We will make no further comment on the sequence of evolutionary steps, although we have done so in a paper that has just appeared in the second volume of "Colloidal Chemistry, Theoretical and Applied,"[2] to which those interested may be referred.

JEROME ALEXANDER
NEW YORK, N. Y.

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[2] Edited by J. Alexander, The Chemical Catalog Co., 1928.

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SCIENCE NEWS

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THE NOBEL PRIZE MEN

THE Duc de Broglie, scientific scion of a proud French family, is wearer of the Nobel laurels for physics for 1929. In this high award, physicists see a compliment to a new way of looking at the phenomena of light, electricity and other stuff of which the universe is made. For Duc de Broglie was the pioneer in the development of that most modern branch of physics "wave mechanics" which the German physicist, Schroedinger, developed to an even greater extent.

The theory of wave mechanics as propounded by de Broglie and Schroedinger makes the differences between matter and radiation a shadowy borderland. An electron, the unit of electricity and the smallest particle of matter, becomes a sort of manifestation of a group of waves, while waves of light or other radiation at times take on the properties of particles. And then at other times matter is best explained as acting like waves of radiation.

All this is disconcerting to those who learned about light, X-rays and other radiations some years ago when they were considered wave motions. Despite the new wave mechanics, the classical wave theory of radiation accounts for ordinary optical phenomena with satisfaction and for practical purpose it is not thrown overboard. Yet wave mechanics explains some mysteries unsolved by earlier conceptions and therefore the physicist is in the position of having more than one fundamental law. He uses the one that fits best, confident in the hope that future progress will destroy their apparent inconsistencies.

One daring prediction made by Duc de Broglie when he first developed his wave mechanics a few years ago was fulfilled by the discovery of the American physicists, C. J. Davisson and L. H. Germer, that electrons, particles of matter, act like waves in the same sense that light and X-rays are waves.

THE investigator who discovered the fundamental laws connecting the production of electricity from a hot wire with the temperature of the wire, a phenomenon utilized to-day by every tube radio set, received the 1928 Nobel Prize, just awarded this year. He is Professor Owen Williams Richardson, director of research in King's College, London, who, from 1906 to 1913, was professor of physics at Princeton University in this country. He is considered father of the branch of physics which he christened "thermionics," which deals with the effect that heat has on matter in generating electrically charged particles, called ions or electrons. While Professor Richardson's work for which he has received the Nobel Prize was done in the interests of the advancement of pure science, his laws find intense practical application in the design of electron tubes now so widely used in radio, the talkies and other applications of physics to industry.

STUDIES of yeasts, sugars and the fermentation of sugars, carried on over many years, won the 1929 Nobel Prize in chemistry for Dr. Arthur Harden and Professor Hans von Euler. Dr. Harden, professor of biochemistry in the University of London and head of the biochemistry department at the Lister Institute, has published a book on alcoholic fermentation, besides reports of his many chemical studies, some of which were in the field of vitamins.

Professor von Euler is director of the new biochemical institute of the Stockholm High School, which is really a university, where he has been professor of chemistry for some years. Like Dr. Harden, Professor von Euler has made studies of vitamins, although his main interest has been in the field of enzymes and sugars. He has published two books on the chemistry of enzymes, besides many reports of studies conducted alone and in collaboration with others.

The studies of Dr. Harden and Professor von Euler are known to chemists in this country, but they have not heretofore attracted wide attention.

THE PRODUCTION OF COTTON

COTTON is still king in the Southland, but his throne is a bit uneasy under him, and in the course of a few years he may have to share domain with younger King Cottons who are growing up in other lands. This is the gist of a prophetic report to *Economic Geography*, by Professor Earl C. Case, of the University of Cincinnati.

The very factors that helped to establish the southern part of the United States as the leading cotton-producing area in the world are now helping in its decline, and in the rise of rival cotton regions. Our cotton belt is a compact block of fertile soil with a climate well suited to cotton growing. But the fertility of the soil is declining, and the climate has been as favorable to the enemies of cotton—boll weevil and the rest—as it was to the cotton itself. Bad years affect the whole area and may cut down the yield fifty per cent., because it is all in one piece; whereas cotton lands elsewhere in the world, being cut up into smaller and scattered blocks, escape in most parts when disaster visits any particular point.

Another important factor that is threatening the supremacy of American cotton is the rise in the cost of cotton-farming labor in this country. Even though the Negro and "poor white" labor of the South is among the worst-rewarded of all American agricultural work, its wage is still many times higher than that of cotton-field workers in South America, India, Egypt, the Sudan and China. And the northward migration of Negroes that has been going on ever since the new immigration laws cut down the supply of unskilled laborers in northern industrial plants is seriously cutting into the rural population of the South.

The apparent determination of British cotton spinners and weavers to reduce the degree of their dependence on American cotton by increasing the quantities of the fiber grown "within the Empire" is another influencing factor. Great new cotton areas have been opened up within the past few years in India, in the Sudan and in Tangan-

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yika; and the cotton fields of Egypt still have strong British connections in spite of the changed political status of that nation. South American nations, notably Brazil and Argentina, are making strong efforts to become at least partly self-dependent.

China, one of the greatest cotton markets of the world, now raises a great deal of low-grade cotton. Professor Case believes that the Chinese farmers, though the world's most obstinate conservatives, may in time be persuaded to introduce improved varieties and to adopt improved cultivation methods. If and when that happens, China will need a great deal less foreign cotton.

THE SAHUARO CACTUS

THE giant sahuaro cacti that stand like sentinels in the southern Arizona desert are fruit trees to the Papago Indians. Their red fruits, filled with sweet pulp, figure so largely on the red man's bill of fare that when the sahuaro and wheat harvests chance to be ripe at the same time he will divide his family into two groups so that he may still gather his share of the "figs from thistles."

In a report to *The Journal of Heredity*, Frank A. Thackery and A. R. Leding, of the U. S. Department of Agriculture, tell of the high value set by the Papago on his cactus crop and of the methods he uses in gathering it.

Sahuaro fruits are the best sources of sugar known in the desert country, and the Indian has as much of a sweet tooth as his Caucasian brother. The Papago make use of the fruits mainly in the preparation of a syrup, which they keep in sealed clay jars until they are ready to use it. It will stay good for a year.

When the fruits show by their red color that they are ripe, a large part of the Papago community leave their villages and journey to their campsites in the midst of the sahuaro "forest." The women have charge of gathering the fruit and preparing the syrup. Gathering fuel and hauling water is the men's job, and since water often has to come from a distance of fifteen miles, the squaws are not necessarily getting the worst of the division of labor.

The women knock the ripe fruits off the tops of the giant cacti with long poles made of spliced cactus ribs and armed with a couple of hooks made of thorns. They pick them up off the ground, slit the skins with a swift slash of the thumb-nail, and empty the pulp into a basket. It takes a good half-day's work to gather fourteen or fifteen quarts of this pulp.

Back in the camp, the pulp, with a little water added, is simmered over a fire in an earthen pot. The cooked juice is strained away from the pulp and then boiled again until it is reduced to a syrup. This is poured into earthen jars and sealed shut.

Besides the syrup, the Indians sometimes prepare preserves of the sahuaro pulp. They also dry some of it without cooking and eat this "as is" or moistened with water during the winter. The seeds left over from the syrup-making are either ground into meal or kept for chicken feed.

SPONTANEOUS COMBUSTION

THE strange phenomenon of hay-racks catching fire through no human agency was recognized as a natural process by wise men of old Rome, and yet two thousand years later the process is still as baffling and inexplicable to modern science as it was to Columella and Pliny. Citing the knowledge of ancient observers regarding spontaneous combustion, Dr. Henry G. Knight, chief of the U. S. Bureau of Chemistry and Soils, recently outlined a program of scientific research which would solve the mystery and enable mankind to forestall the destructive process. Dr. Knight, speaking before the Conference on Spontaneous Heating and Ignition of Agricultural and Industrial Products, in session at Washington, D. C., said: "There is evident need of careful investigation of the exact conditions that produce the spontaneous ignition of agricultural materials as the basis for our future course of action. It will require a cooperative investigation by chemists, bacteriologists and engineers upon quantities of materials sufficiently large to duplicate actual farm conditions."

Outlining the points requiring special attention, he said:

"Chemical analyses should be made of the fresh material and the chemical changes which take place throughout the heating period should be noted carefully. The rate of heating in different parts of the mass should be determined. The avidity for oxygen of the fresh and fermented material should be studied. The migration of moisture throughout different parts of the experimental material should be carefully observed. The production of gases and their character should receive study. The effects of aeration at various stages of storage should be recorded. Studies of conditions existing in the areas of high heats should be carried on, and the various methods of curing in the case of hay and the effects of adding other substances such as salt to hay and to cattle feed should receive special study. Along with this work and based upon it should be studies of methods directed at the reduction of spontaneous heating and actual firing of agricultural materials."

Spontaneous ignition costs American farmers millions of dollars a year, and the chief products which go up in smoke or are spoiled for use by this cause are hay, grain and horse manure.

TREATMENT OF COLDS

BECAUSE colds are not unchanging but have three distinct stages, treatment must be planned for each stage, Dr. Walter A. Wells, professor of otolaryngology at Georgetown University, has advised. Treatment by a physician will do much to relieve the discomfort and shorten the duration of a cold, but not every one can have medical treatment for all colds. Remedies to apply at home are described by Dr. Wells in his recently published book.

In the first and second stages treatment should be general, not local, so as not to irritate further the tender membranes of the nose. Dr. Wells describes the first

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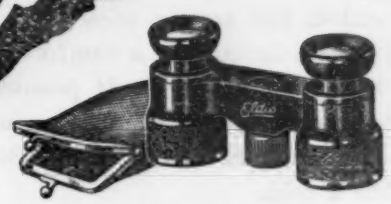

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stage as the one when there is stuffiness, chilliness and possible fever and general discomfort. In the second stage there is marked secretion of watery acrid material. This changes to a mucous or muco-purulent discharge during the last stage.

Prevention is the best of all home remedies for a cold, Dr. Wells stated, but having once got a cold, the wise thing is to remain indoors in a comfortable warm room, resting in bed for a day or so if possible. Cold baths, cold showers and strenuous exercise, valuable hardening methods in the intervals between colds, should be stopped while one has a cold.

"Nothing could be farther from the right than the injunction, 'Feed a cold and starve a fever,'" Dr. Wells explained. "A cold is a fever, the inflammation being localized in the respiratory mucous membranes. Overloading the stomach is directly harmful, and meats, gravies, fried stuff and richly spiced food are especially to be avoided."

Plenty of fluids, including milk and fruit juices, are advisable. For the beginning stage of a cold, free perspiration helps and for this hot drinks may be taken.

During the acute, feverish stage of a cold, the blood tends to be less alkaline than usual. To combat this, alkaline treatment, such as taking bicarbonate of soda in water, is advised. Gentle local treatment may be begun in the second stage. Steam inhalation of menthol or menthol and eucalyptus are healing and soothing. For the last stage of a cold, alkaline antiseptic solutions used locally as a douche are in order.

The chlorine treatment of colds Dr. Wells and his associates found was frequently helpful in simple uncomplicated cases when used in the first stage. When tonsils or sinuses were involved this treatment had little effect. Dr. Wells has found no scientific foundation for the now-popular vaccine treatment of colds, and attributed the occasional good results from it to coincidence.

PREHISTORIC INDIANS

INDIANS of prehistoric America constitute rare material for the laboratories of science, Dr. A. V. Kidder said in a lecture at the Carnegie Institution of Washington on November 12.

Dr. Kidder, who directs the archeological activities of the institution, spoke on the oldest known inhabitants of America and their importance to science. Two factors, he said, combine to create an unparalleled opportunity in the Southwest for study of the growth of early human culture. The first is the favorable climate of the Southwest, where shriveled mummy-like bodies of Indians who lived before the time of Christ have been preserved in the dry hot earth. These burials and possessions of the Indians found with them and in their shelters enable archeologists to study the progress of their culture in the greatest detail, Dr. Kidder pointed out.

The other favoring factor is the scarcity of water in the Southwest which caused the Indian groups to congregate where water supplies were good and to inhabit the same places, generation after generation. Thus the remains of their habitation have accumulated in the soil in successive layers and scientists can use principles of stratigraphy in determining the relative age and the order of development of various groups.

The remains thus preserved are worth study because they reveal the course of progress when human beings succeeded in taming a wild grain to insure a cereal crop. The transitions of the nomadic and farming periods are lost in Egypt and Mesopotamia. In the Southwest, where corn was the cereal crop, the earliest farmers, the basket makers, grew only a primitive variety. Later, the cliff dwellers and Pueblos grew a number of kinds, and improved the crop. The development of farming brought leisure to the people and made home life possible. Building arts could be experimented with, and community life with rites and rules became complex.

ITEMS

THE division of fish and game of the California Department of Natural Resources reports a novel method for securing natural food for baby trout, used by J. W. Ricker at the Cold Creek hatchery. An insect trap in the form of a funnel-shaped cloth sack, over which was suspended an electric light, was hung near the water and the light left burning the entire night. In this way, using a number of traps, several hundred pounds of insects were collected and fed to the young trout. Mr. Ricker said the captured insects provided splendid food, but that this diet should be supplemented by other types of food, as the young trout did not do so well unless their diet was varied.

BISON herding may yet come to rival reindeer raising, the newest of Alaska's great industries, if the preliminary experiments reported by L. J. Palmer, of the U. S. Biological Survey, prove successful enough to justify their extension on a larger scale. About a year and a half ago, Mr. Palmer states, 23 head of bison were shipped to the northern territory from the National Bison Range, Montana. Nine were released near the town of McCarty, and fourteen held at the reindeer experiment station at Fairbanks. The animals came through their first winter in good shape, in spite of heavy snows, feeding on natural fodder, chiefly the wild vetch.

REINDEER moss, the crisp and curly lichen that is the chief dependence of reindeer in the far North, is an enemy of forest growth farther south, reports Anna E. Allen in *Ecology*. This lichen is by no means confined to the lands where reindeer pasture, but grows over great areas, especially as a ground cover under trees, as far south as Florida and Mexico. It forms dense mats like fine shavings, and the seeds of trees and other plants, caught on top, are held away from the moist earth where they might sprout and grow. They just hang there in the air until they die of drought. Even if they do work their way down to the earth and sprout, their troubles are not necessarily over. The reindeer moss heaves and moves about restlessly as it is alternately wetted and dried, and in doing so frequently breaks or uproots seedlings that have pushed their way through its meshes.

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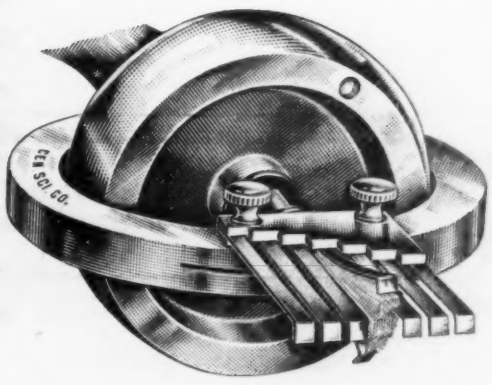

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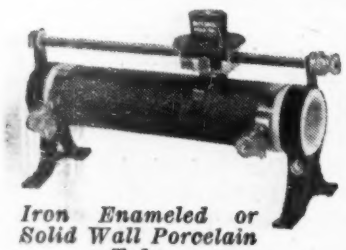

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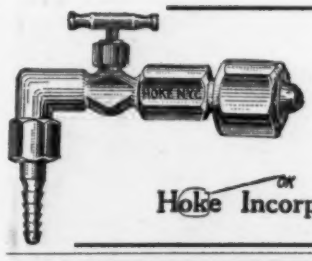

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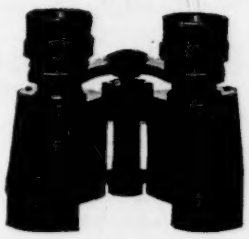

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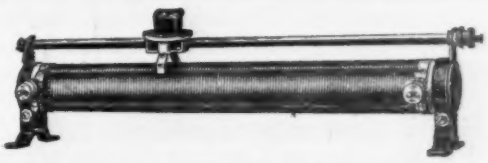

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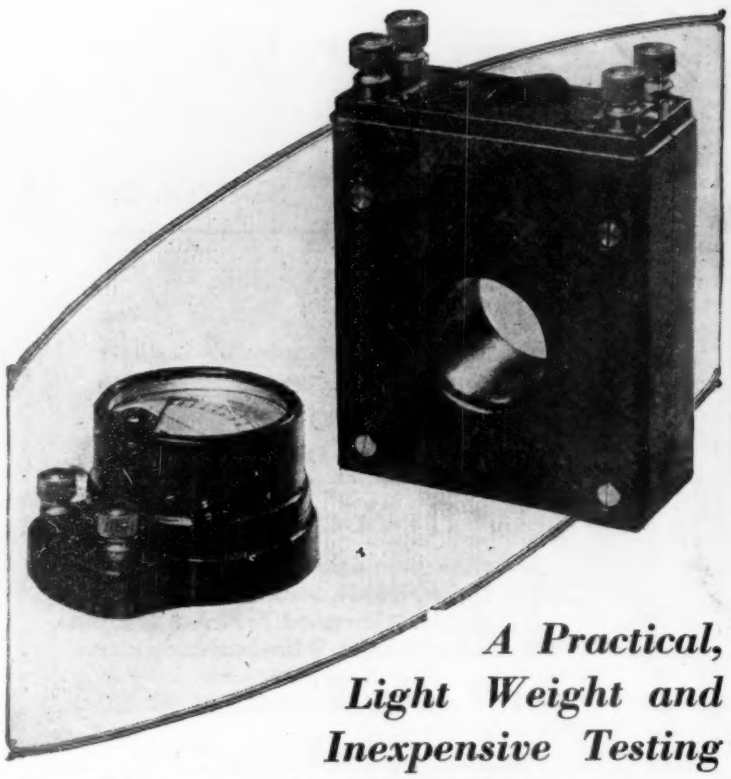

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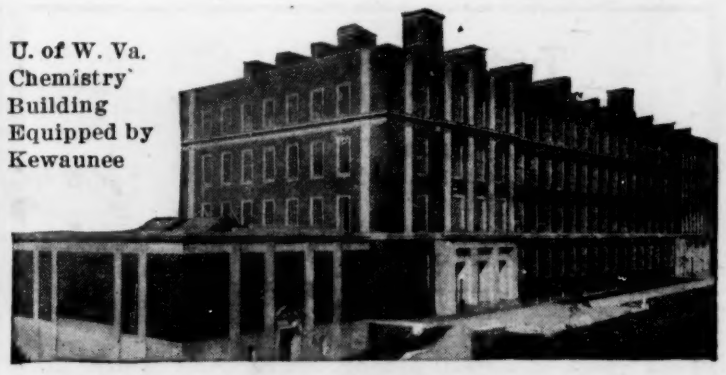

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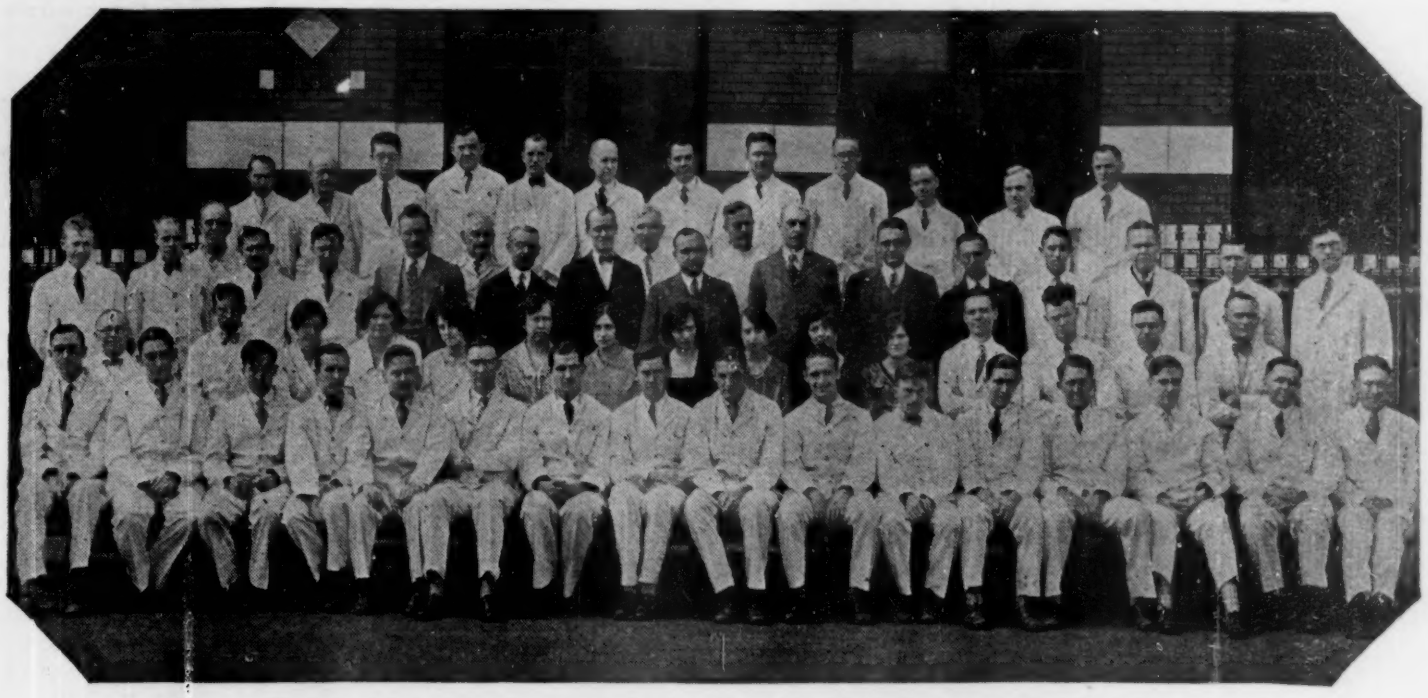

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